Popular Science

MONTHLY Founded 1872 SM

September
1930
25 cents

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Can a Plane Rise *Straight Up?*

How to Get a GOOD PATENT

Vacuum Tube a Mile Long

Perfect Golf Swing Found and Explained

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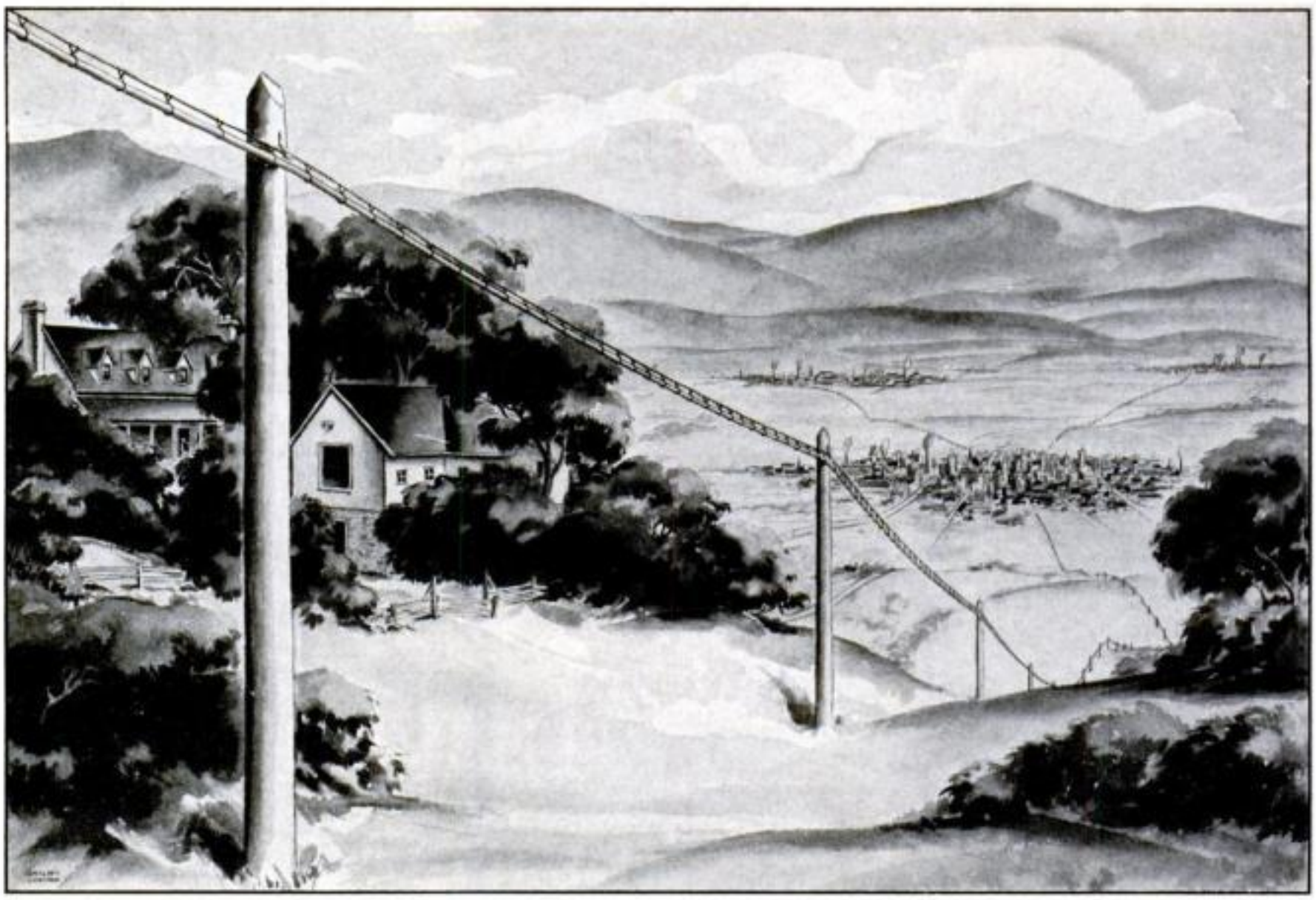

AN INTER-CITY CABLE, PART OF THE BELL SYSTEM NETWORK THAT UNIFIES THE NATION

Vast, to serve the nation . . . personal, to serve you

An Advertisement of the American Telephone and Telegraph Company

So THAT YOU may telephone from house to house in a Southern village, from farm to farm in the Middle West, or from the Pacific to the Atlantic Coast—the Bell Telephone System *must* be large. Its work is to give adequate telephone service to one of the world's busiest and most widespread nations. There is 4000 million dollars' worth of telephone plant and equipment in the Bell System, any part of which is subject to your call day or night.

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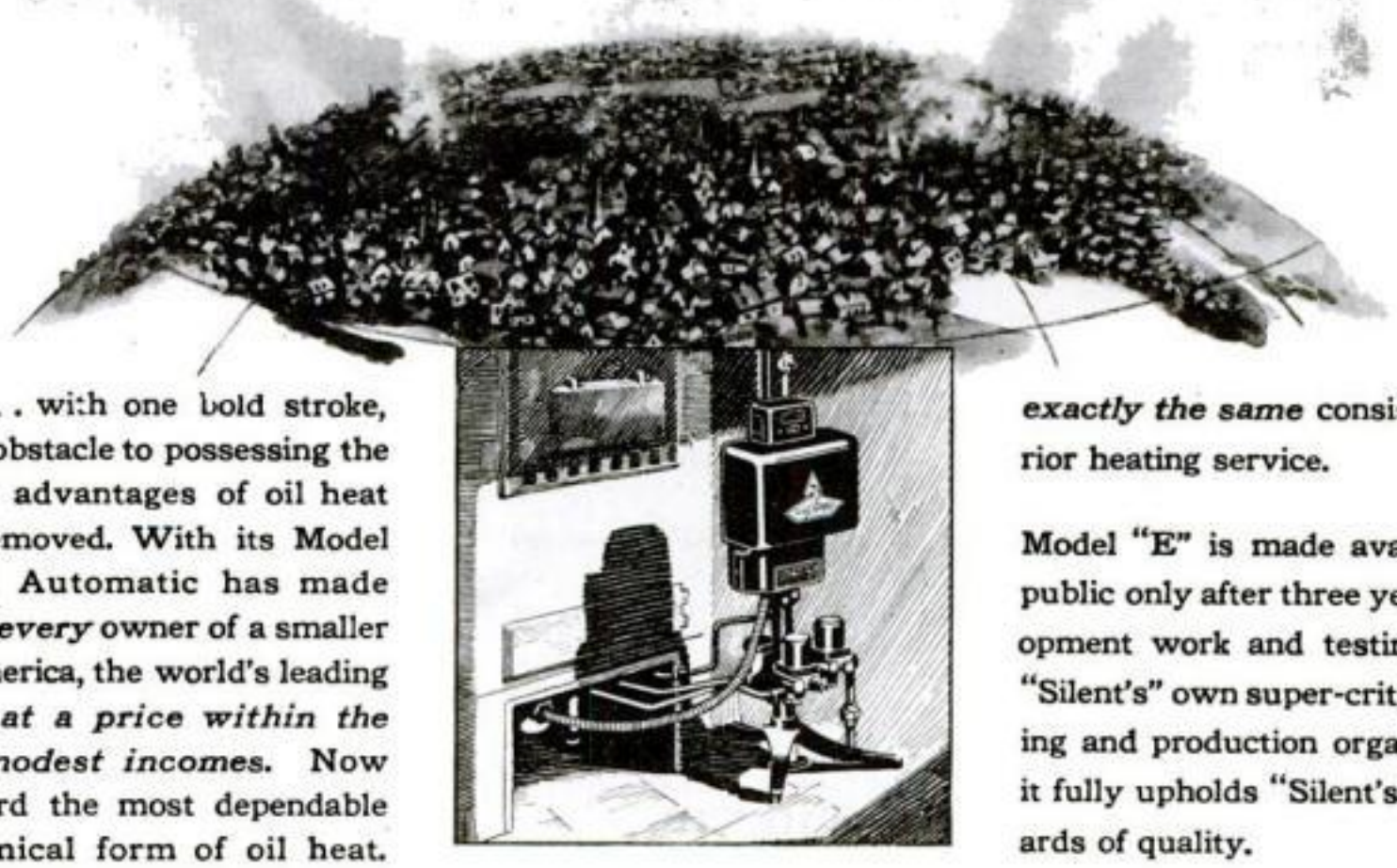
The Bell Laboratories and the Western Electric Company utilize the talents of thousands of scientists for constant research and improvement in the material means of telephony. Western Electric, with its great plants and warehouses in every part of the country, contributes its specialized ability for the precise and economical manufacture of equipment of the highest quality for the entire system.

The Bell System is vigorously carrying forward its work of improving the telephone service of the country. It is building for today and tomorrow—for the benefit of every one who lives and works in America.

Ten Million Owners of Smaller Homes

WERE WAITING FOR MODEL "E"

The World's Largest Producer of Domestic Oil Burners NOW Makes the Advantages of Silent Automatic Oil Heat Available to ALL Homes



NOW . . . with one bold stroke, every obstacle to possessing the inestimable advantages of oil heat has been removed. With its Model "E", Silent Automatic has made available to *every* owner of a smaller home in America, the world's leading oil burner, *at a price within the reach of modest incomes.* Now *all* can afford the most dependable and economical form of oil heat.

We want to impress this fact on everybody: Model "E" is in every respect, except price and size, the *twin brother* of Model "A", with which "Silent" achieved world leadership in the production of domestic oil burners. It will deliver *exactly the same* consistently superior heating service.

Model "E" is made available to the public only after three years of development work and testing convinced "Silent's" own super-critical engineering and production organization that it fully upholds "Silent's" rigid standards of quality.

We'll gladly give you all the facts on Model "E". The coupon will bring you the name of the nearest "Silent" dealer and information about the remarkably easy terms on which Model "E" may be purchased.

(313)

SILENT AUTOMATIC

THE NOISELESS OIL BURNER

SILENT AUTOMATIC CORPORATION
12001 East Jefferson Ave., Detroit, Mich.

Without obligation on my part, please send me a copy of your new booklet, "Oil Heat for the Smaller Home", on the new Model "E" Silent Automatic Oil Burner.

My home has_____rooms. Heating system is
☐ Steam; ☐ Vapor; ☐ Hot Water; ☐ Warm Air.

*Name*_____
*Address*_____
*City*_____ *State*_____

Ⓢ This seal on an advertisement in POPULAR SCIENCE MONTHLY signifies the approval of the INSTITUTE OF STANDARDS. See page 8.

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$2.50 a Year

Popular Science
MONTHLY Founded 1872

381 Fourth Avenue
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September, 1930, Vol. 117, No. 3. **Popular Science Monthly** is published monthly at 381 Fourth Avenue, New York, N. Y., by the Popular Science Publishing Co., Inc. Entered as second-class matter Dec. 28, 1918, at the Post Office at New York under the act of March 3, 1879; additional entry as second-class matter at Chicago, Illinois. Entered as second-class matter at the Post Office Department, Canada. Printed in U. S. A. Single copy, 25 cents. Yearly subscriptions to United States, its possessions, and Canada, $2.50; foreign countries, $3. O. B. Capen, President and Treasurer; R. C. Wilson, Vice-President; A. L. Cole, Vice-President and Secretary.

Popular Science Monthly for September, 1930

Models

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When Is It Safe To Speculate?

LEON MEADOW, Financial Editor

"I HEAR Dennison was caught short for a nice lump of money" . . . "yes, and I understand Garrity took a beautiful tumble" . . . "Don't you think Holcomb's making a bad mistake in putting up more margin, instead of taking a small loss now? . . . "Well, it's rather hard to say; he's a pretty shrewd bird. Made a pretty penny on the April rise, I hear" . . .

The scene was the smoking car of the 5:37 Sundale Express, and every man's conversation was limited to discussion of the June decline that had brought market prices close to, and in some cases under the low point of the famous November crash.

John Powell turned to his friend, sitting next to him. "You know, Dave . . . the market must exercise some form of hypnotism on these men around us. Otherwise its fascination for them can't be explained. Certainly, most of them wouldn't be caught in the web if they had been in full possession of their senses, and consciously awake to every day realities and necessities."

Dave Carroll smiled, a trifle mechanically. "You, of course, aren't concerned. But the rest of us poor mortals have been stung. Just wait, Mr. Powell, you'll get yours one of these fine days. Lord knows how you've escaped this long."

"I'll tell you how," his friend replied. "I believe that you and I and most everyone is a gambler at heart. But the main road branches off two different ways from that point. Some men, like the fellows in this car, make splendid salaries or draw good money from their business. They live very comfortably, can afford certain luxuries, and certainly are not pressed for daily necessities. This apparent financial solidity lulls them into a position of false security and makes it very easy for them to forget about the distant future. When they do have a few thousand dollars to spare, the market acts like a magnet on that gambling itch of theirs. Those are the men who turn left of the fork.

"Now let me talk for the other group. who turn right. They're cautious—but hardly 'stick-in-the-mud' minded, by a long shot. They're gamblers at heart, too. But they don't indulge until everything else has been accounted for. They not only make sure of their financial security for today—but also try to lay the foundation for a structure that will be standing tomorrow, as well. And until they have done all that is possible to assure themselves and their families of complete protection, they simply do not hear the market when it calls."

"Now," began Dave Carroll, "let me say a few words for my bunch—or rather let me use my own case to bring out my point. I've been making $10,000 a year and saving about $2500. I don't think I've wanted to gamble with that any more than you did with your savings. But I did want an investment with a good yield and fair prospects for advance in value—so I turned to common stocks. Now hold on, John—I know you're going to say I've speculated. But did I? I chose the common stocks of the leading industrial and railroad companies in the field. Good, sound stuff—and now look what's happened. One's off 18 points and the other 10."

"Exactly," interrupted Powell, "that loss in itself proves that the investments were speculative from a standpoint of risk. But over and above that, it proves my point. When I've arranged my affairs so that there isn't a possible leak in my income—when I've gained complete protection and independence for Alice and the children, and made certain of an income to fill up the gaps in the down grade—then, and then only, will I put any extra money I have in common stocks, perhaps of the same nature as yours. I may lose, as you have, but I won't be licked. Don't you see, Dave, that no matter how safe and sound common stocks may seem to be, they're always hit hardest by these upheavals, they will always be subject to sliding price variations. That's why they're speculative ventures. If you put money that should be used in building up a sound financial future for you and your family, into the most apparently safe common stock, you are indulging in plain, out-and-out speculation, never worth the price you sometimes pay. When the time comes for me to play around with what I consider is extra money, the outcome of my experiments cannot threaten my financial security."

"I'm curious, John. What have you done to date, toward that financial security of yours—and when do you think the time will come when you can afford to 'speculate' in common stocks?" Carroll asked.

"Well," Powell began, "there isn't time for complete details—but here's the story briefly. I'm making $7500 a year and using $5000 for all living expenses. $1300 of the $2500 left over goes to insurance premiums. I'm now carrying $60,000 worth of endowment policies. If anything happens to me, Alice and the children will be assured of $3000 income for life.

"That leaves me with $1200. Out of that, $500 goes to the savings bank each year. Before I ever touch a common stock investment, there's going to be a balance of $5000 in the bank. I never will expose myself to (Continued on page 5)

When Is It Safe To Speculate?

(*Continued from page 4*)

any unforseen emergency without plenty of ready cash in the bank.

"$700 still remains. Each year that sum of money will go toward the purchase of gilt edge bonds and preferred stocks, yielding between 4½ and 5%. If they're not safe, the banks better start closing their doors now. The common stock market will never hear from John Powell until he has a good $25,000 worth of bonds and preferred stocks in the vault. I've worked the whole thing out on paper as accurately as is possible when forecasting anything like this. Here's a summary of my plan, assuming, of course, that I can maintain the same savings ratio under increased salary and increased living expenses.

"Annual Savings Deposits of $500 at 4¼% interest compounded quarterly will bring me right up to the $5000 mark in eight years. In that time the additional surplus of $700 a year will have purchased, by reinvesting the interest, close to $7000 worth of securities. Then, beginning with the 9th year I can discontinue my Savings Deposits and apply the whole $1200, plus about $200 yearly interest from the savings account,—for a total of $1400—toward the purchase of bonds and preferred stocks each successive year. In nine more years my total security holdings will be worth well over $25,000, with an annual return of nearly $1200.

"Should anything happen to me then, my wife and children will enjoy an income of $4200—$3000 from insurance and $1200 from investments. On the other hand, if I'm still going strong, that $1200 security yield will almost offset my insurance premiums, and again there'll be more money on hand for the purchase of more bonds.

"I started this program two years ago, when I was 34. In 17 years, at 51, it will be complete. Between that age and 70, when my endowment policy matures, I must reasonably assume that my earning powers will be on the decline. Then my total outside income, above what goes to insurance premiums, will be about $1500. That sum of money must fill in the gap made by decreased earnings. Since I can reasonably expect my children to be married by then and my family expenses to be so much the less, I'll be able to carry on comfortably till I'm 70. But by then I've been working long enough, and I will want to retire. So that the income from the matured $60,000 policy will be put right into service toward that purpose.

"This has all been based on reasonable calculations and circumstances. If my earnings should increase tremendously, the surplus above my protection needs may be turned to other channels. On the other hand, if everything runs according to plan, my family and I will be secure, but I can never afford to speculate.

"And that goes for Dave Carroll and thousands of men in similar circumstances. Till (*Continued on page 6*)

When Is It Safe To Speculate?

(*Continued from page 5*)

they have provided their families and themselves with a gilt-edge, fool-proof financial program, common stock investments are speculations, selfishly unjust to those they want to and must protect. Men who do that are playing another man's game. And what's more, they're trying to beat a game that too frequently licks those who devote to it all their time, energy, money and brains. Yet these men take it up as a side-line, with an amount of knowledge that would make them seem ridiculous in any commercial venture. What's the sense of playing with T. N. T.—when you don't even know how to handle it?

"While it's none of my business, I'll bet there are plenty of men on this car now who haven't the slightest right to be speculating with the extra funds they have—and from their talk, plenty of them who are sadder, but wiser for having done so.

"Say, this is Sundale—I'd better be getting off, while the getting's good! So long, Dave—see you on the 8:02."

To Help You Get Ahead

THE Booklets listed below will help every family in laying out a financial plan. They will be sent on request.

Your Income and Your Life Insurance is the name of a brief booklet scientifically answering the question "How much life insurance does a man really need?" Provident Mutual Life Insurance Company of Philadelphia, Pennsylvania, will mail a complimentary copy upon request.

The House Behind the Bonds reminds the investor of the importance, not only of studying the investment, but of checking up the banker who offers it. Address: Fidelity Bond & Mortgage Co., 1188 New York Life Building, Chicago, Ill.

How to Get the Things You Want tells how you can *use* insurance as an active part of your program for getting ahead financially. Phoenix Mutual Life Insurance Company, 328 Elm Street, Hartford, Conn., will send you this booklet on request.

Enjoy Money shows how the regular investment of comparatively small sums under the Investors Syndicate plan, with annual compounding of 5½% interest, builds a permanent income producing estate, a financial reserve for a business, or a fund for university education or foreign travel. Write for this booklet to Investors Syndicate, Investors Syndicate Building, Minneapolis, Minnesota.

How to Retire in Fifteen Years is the story of a safe, sure and definite method of establishing an estate and building an independent income which will support you the rest of your life on the basis of your present living budget. Write for the booklet to Cochran & McCluer Company, 46 North Dearborn St., Chicago, Ill.

See How Easy It Is tells how it is possible to start off with a definite plan for creating an immediate estate leading to future financial security. Get your copy of this booklet by writing to Postal Life Insurance Company, 511 Fifth Avenue, New York City.

Now, You Can Paint, Varnish or Enamel with Brushes Constructed Specifically for Each Job

It is no longer necessary to waste a good paint with the wrong brush. Startling presentation by Whiting-Adams enables amateurs to get expert results on every job. "Painting Hints That Help," sent free.

FOR PAINT
Here's a brush constructed specifically to give you the best-looking paint job you ever had. The box is plainly marked "Brushes for Paint."

FOR VARNISH
No danger of trying to varnish your ship model with a paint brush. The box tells you that this is the brush for varnish work.

FOR ENAMEL
Here it is, plainly identified as the correct brush to give a gleaming new finish to your porch chairs or anything else you want to renew with enamel.

Send for this valuable FREE Booklet
"Painting Hints That Help," lives up to its title. You will find yourself turning out better work, achieving finer results on all kinds of paint jobs after you get this free booklet. There's no obligation. Just use the coupon.

PROFESSIONAL painters have always had two definite advantages over people who paint for fun. First, they have known that satisfactory results could be secured only through the combination of good paint and good brushes. Second, they have known that each kind of work required a special kind of brush. The non-professional painter hasn't realized that a good brush gives superior results and is cheaper in the long run And he hasn't known how to choose the right brush for the right job.

The question of a good brush has held no terrors for users of Whiting-Adams brushes during the past 122 years. The question of the right brush has now been solved with the introduction of display cartons identifying the correct brush for each job. Plainly marked boxes of paint brushes, varnish brushes and enamel brushes displayed by your dealer help you make the intelligent selection of an expert

You can't go wrong on your brush choice now Suppose you've just bought the paint to brighten up the bird house up on the hill Then turn to the carton marked "Brushes for Paint." The high quality is safely taken for granted when you see the name of Whiting-Adams. And you know that these particular brushes were intended for, even designed for, paint work.

Use this safe new way of brush selection made possible by Whiting-Adams. A good brush for all jobs and the right brush for each job You will find Whiting-Adams brushes at good paint and hardware stores.

WHITING-ADAMS COMPANY
700 HARRISON AVE. BOSTON, MASS.

WHITING-ADAMS CO.
700 Harrison Ave.
Boston, Mass.
Please send me the helpful, free booklet, "Painting Hints that Help."
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Street_____
City_____ State_____
Name of dealer_____
WHITING-ADAMS COMPANY
700 Harrison Avenue, Boston, Mass.

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Guaranteed Advertisements

Popular Science GUARANTEE

POPULAR SCIENCE MONTHLY guarantees every article of merchandise advertised in its columns. Readers who buy products advertised in POPULAR SCIENCE MONTHLY may expect them to give absolute satisfaction under normal and proper use.

Tools, Radio Apparatus, Oil Burners and Refrigerators advertised in POPULAR SCIENCE MONTHLY have been tested or investigated by the Popular Science Institute of Standards and each advertisement carries the insignia indicating approval.

However, other products advertised in the magazine not subject to test carry the same guarantee to readers as products tested.

THE PUBLISHERS

Automatic Heating with Coal

Why Shovel When a Stoker Will Do the Work for You?

By COLLINS P. BLISS,
Director of Popular Science Institute

SUCH a thing as leaving a house empty for several days and having the coal automatically shoveled, the ashes automatically emptied, and the temperature automatically controlled may seem beyond the possibilities of this automatic age, but it is an accomplished fact. Gas and oil are not the only fuels that permit a high degree of mechanical control; now coal, too, can be burned with a minimum of attention.

The rapid development of all types of automatic equipment has resulted in a demand for a degree of convenience that cannot be measured in terms of direct monetary savings. The mechanical refrigerator is, for example, valued for considerations other than the low cost of operation. Similarly, the mechanical coal-burning equipment that saves trips to the cellar raises the utility of the heating system far above the mere gain in efficiency.

The effectiveness of thermostatic devices in reducing the amount of manual regulation of the furnace should not be underestimated. However, there is a strong demand for more complete relief from heating care than merely that provided by the automatic control of the fire. A large number of home owners have become so insistent that their heat be supplied automatically that they are displaying a willingness to disregard cost and other vital items in order to purchase that equipment which seems to them to offer the best solution of the problem of furnace attention. Through the use of automatic stokers, coal can be used as a fuel without the sacrifice of economy, cleanliness, or safety.

HOW STOKERS WORK

Three principles of design have been incorporated in domestic stokers—underfeed, with combustion taking place in tuyeres; and overfeed, in which coal is fed either at the periphery of a revolving grate or at the end of a traveling grate.

One stoker, recently developed, embodies a revolving grate onto which a measured supply of coal is fed and then pushed toward an ash hole in the center by the combined action of the fresh coal and a spiral dead plate at the circumference of the grate. This stoker includes a special boiler as an integral part of the installation.

A stoker of the overfeed type, now being actively marketed, includes an elevated magazine from which buckwheat or pea anthracite is fed to a thermostatically controlled distributor or flipper which, by reason of its irregular surface and relatively high speed, distributes the fuel evenly over the surface of the grate.

ASHES REMOVED

An important feature of the outstanding stokers is their provision for removing ashes from the furnace and depositing them in easily accessible sealed cans for periodic removal.

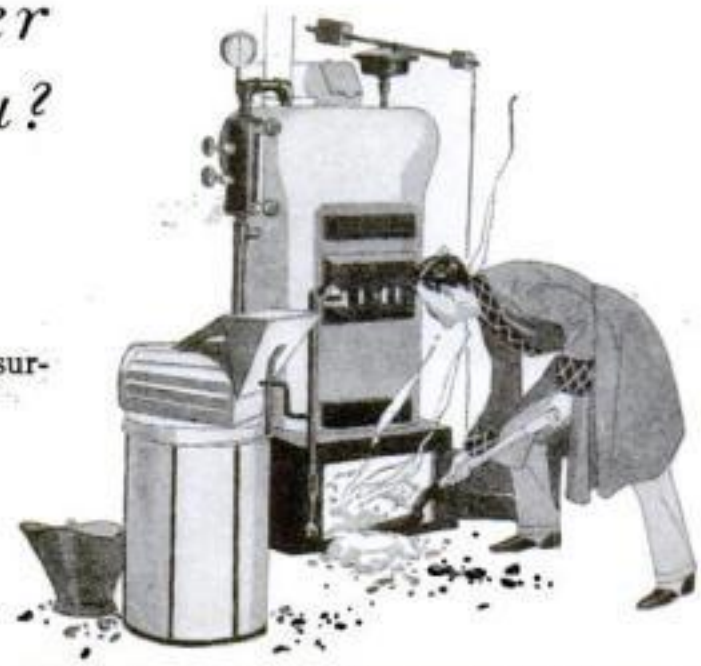
One of the best known stokers includes a screw conveyor which brings the ashes to the front of the furnace where they are automatically deposited in a covered can. In this instance the can is above the floor where it may be readily removed and replaced with an empty can. Another make of stoker also provides for dustless ash removal by ejecting the ashes into a receptacle located in a covered pit under the cellar floor. A third make includes an ingenious and simple device which automatically fills two large cans in turn. The subsequent removal of the ash cans from a covered pit is easily accomplished by means of an inexpensive chain hoist suspended from a small monorail carrier.

The labor and attention saved by the incorporation of ash removing features as a part of the domestic stoker are apparent. Their utility from a standpoint of cleanliness also carries a particular appeal to the modern home owner.

GRAVITY FEED

A further feature of automatic stokers is the ease with which they are adapted to the use of overhead hoppers from which coal, as delivered from the retailer, is fed by gravity to the fuel bed. By thus eliminating the necessity for either fuel or ash handling, the stoker can be depended upon to keep the house warm for long periods of time without attention of any kind.

That such a plan is practical rather than merely theoretical has been demonstrated in a Rosemont, Pa., home where the owner wanted to leave his house unoccupied for several days at a time during which absolutely no attention could be given to the fires. A stoker has been installed and is operating to the perfect satisfaction of the owner, who now absents himself with the assurance that his home will not be subject to a fire hazard and will be comfortable when he returns.

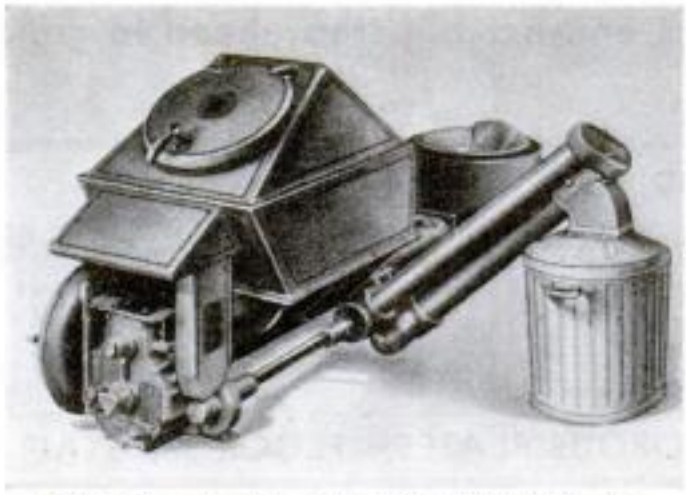


This unpleasant feature of shoveling coal in and digging the ashes out is entirely done away with after an automatic stoker and ash remover has been installed.

MODERNIZED CELLAR

The former objections to the use of cellars for living quarters and recreation rooms have been disproved since the advent of automatic heating equipment. There is, in fact, a strong tendency to utilize the basement for purposes for which it was formerly considered necessary to add an extra floor. Although the heater room has been segregated from the remainder of the basement when the larger sizes of coal are used, it is more desirable in smaller homes, and also often less expensive, to provide a fully automatic system including an overhead storage bin and stoker, and then locating the living quarters in the same room as the heating plant. The result is added space in the home without a proportionately increased expense.

The saving in labor, increased cleanliness, and added space that such automatic coal burning equipment provides are in line with the modern trend and will be more and more used as a solution to the heating problem.



A typical coal stoker that feeds the fuel to the furnace and carries the ashes out to a covered can.

Readers who want further information on heating with coal, as well as comparative costs on heating with coal, oil, and gas, will find helpful data in the Institute's thirty-eight page booklet, "House Heating and Ventilating", which aims to provide a comprehensive and impartial knowledge of modern methods and equipment available in the heating field and a sound basis for making an intelligent selection. To secure "House Heating and Ventilating", send twenty-five cents to Popular Science Institute, 381 Fourth Avenue, New York, N. Y.

Masonite protection *costs you nothing*

One of fifty beautiful Masonite-insulated homes built by The Keyes & Treuhaft Co., Cleveland. Interior view below

THESE days there's no valid reason for modern homes being stuffy in summer, cold in winter, or damp and chilly at any time. Heat, cold and moisture can be controlled . . . kept where they belong . . . by Masonite Structural Insulation. You can have constant home comfort.

Today Masonite is essential in well-built homes. Its use is a wise investment, in new building or remodeling, whether your plans are modest or pretentious. Masonite comfort really costs you nothing, because Masonite pays for itself by replacing other building materials, by reducing fuel bills and by increasing the re-sale value of your home.

Masonite resists heat, cold and moisture when used as sheathing for walls and roofs; makes sound-resisting partitions and ceilings; builds extra rooms in cellars and attics. As a plaster base, Masonite Insulating Lath produces a fine, smooth finish, and eliminates wall and ceiling streaks.

Carpenters and home mechanics like the easy workability of this sturdy wood board. You can buy it at leading lumber dealers, and you car learn of its many uses in the Masonite booklet. Send for a copy; no cost.

MASONITE CORPORATION, 111 W. WASHINGTON STREET, CHICAGO, ILL.

Masonite

STRUCTURAL INSULATION • INSULATING LATH
PRESDWOOD • QUARTRBOARD

W. B. Rosevear residence, Birmingham, Mich. Masonite sheathing and stucco base. Architect, Clair W. Ditchy; builders, Broock Heinmiller

One of twenty-five Pittsburgh homes built for Chartiers Realty Co., by Key Building Co.

In this Mentor, O., home, designed and built by R. M. Case Co., Masonite added little to the cost

Made Better at Less Cost with Masonite Presdwood

Manufacturers of a wide array of articles—refrigerators, radios, kitchen cabinets, boats, toys, billboards, motor truck bodies, etc.—are building stronger, more durable products, and at less cost, with Masonite Presdwood. This smooth grainless wood board will not crack, chip, split, splinter or warp. Resists heat, cold and moisture. Easy to work with. Home mechanics also find many uses for it. Get the Presdwood booklet. Check coupon.

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111 W. Washington St., Chicago, Ill.
Please send me, free, the story of Masonite.

Name.....

Street.....

City..... *State*.....

☐ If interested in Masonite Presdwood check here.

Our Readers Say

Something Vitally Wrong wi'h Us

SINCE February there has been something vitally wrong with your magazine: You have been and are manhandling Mr. Paus's fine pictures. I think it would be 100 percent better to remove the list of important articles from the cover and give Mr. Paus the room he deserves. Inside, however, your magazine gets better and better. Keep it up.—W. F. H., Hollywood, Calif.

$10,000 Science Prize Is on Its Way

WHAT is the present status of your $10,000 prize for the year's outstanding achievement in science? I have not seen anything in the magazine about it for several months.—F. B. D., Madison, Wis.

The Committee of Award has organized and is surveying the scientific field through colleges, scientific societies, research laboratories, and individual scientific workers in all parts of the country. At the present writing, the period covered by the Award (July 1, 1929–June 30, 1930) is just closed, and nominations are beginning to pour in. Announcement of the bestowal of the Award will be made in the autumn.—The Editor.

Is He Only Right or Right Only?

IN POPULAR SCIENCE MONTHLY for June, in the eleventh line of the article "Man Third in Speed but First in Endurance," occurs the following sentence: "The horse is only capable of forty miles an hour." The word "only" qualifies the speed and not the word "capable." For instance, the correct way is "I receive only $10 a week," not "I only receive $10 a week."—H. E. D., Sturgeon Bay, Wis.

Streets of Water Fine for Mosquitoes

E. C. G. OF New York City proposes streets of water to relieve traffic and do away with noise. Did he ever stop to consider what a problem such a street would raise in the South with mosquitoes? Oil could not be used satisfactorily on the water and there would be the constant expense of keeping the water fresh. The noise problem would not be solved because motor boats make more noise than autos. It certainly would make travel more dangerous for those who could not swim. And what about the tourist? Would he have to leave his car outside the city while he went sightseeing?—A. K. G., Baton Rouge, La.

Patent Office Worse Than We Say

I RECENTLY have had some experience in obtaining a patent and I know the situation at the Patent Office to be much worse than your article brings out.—O'N. W. C., Augusta, Georgia.

Calls Patent Articles Yellow Journalism

MY HIGH regard for your magazine makes it seem all the more lamentable that it should stoop to yellow journalism. Without apologies to anyone, I want to go on record as saying that your statements are born of ignorance.—E. B. B., Portland, Ore.

Senator Metcalf Agrees about Patent Office

I QUITE agree with you about the conditions in the Patent Office. I have been trying to correct the conditions there for some time, but without much success. I realized several years ago that it was necessary to put on more examiners, but I am not sure that is all the trouble which exists there.—Jesse H. Metcalf, U. S. Senator from Rhode Island.

Garbled and Unfair, Says This Philadelphian

IF IT was the intention of your magazine to benefit Patent Office conditions, you have certainly been remiss in failing to select someone who could speak with authority and truthfulness on existing conditions instead of accepting and printing such a garbled and unfair description of what has taken place in the Patent Office in the last few years.—R. M. B., Philadelphia, Pa.

Is Now and Has Been a National Disgrace

PATENT OFFICE a National Disgrace—is now and has been for many years past. Congratulations on the forceful manner in which the truth has been presented.—F. X. R., Valley Park, Mo.

Senator Capper "Thinks Something Should Be Done"

I HAVE read it (Patent Office Has Become a National Disgrace) with great interest. It contains rather startling information. I fear there is too much truth in the statements made by the writer. So far as I personally am concerned I will support any practical measure that will better conditions in the Patent Office. I think something should be done.—Arthur Capper, U. S. Senator from Kansas.

Ouch! Says We Should Be Barred from Mails!

IN YOUR valueless monthly you refer to the Patent Office as a "national disgrace." Your magazine should be barred from the mails for such malicious statements.—I. U. T., Boston, Massachusetts.

Bull Terrier Annoyed by Steaming Furnace

I DISAGREE with Prescott Lecky on one thing: The police dog picked out his master's wallet by scent, not because of the cash in it. I have a Boston bull terrier that is real smart. One day when our furnace was steaming, he came and pulled my mother's dress until she went down and turned off the furnace. Would a cat have done that?—N. B., Queens Village, L. I., N. Y.

Gives Us an O.K. from Cover to Cover

I HOPE it won't be long before POPULAR SCIENCE MONTHLY adds another page of spice such as "Our Readers Say." I'm sorry I can only say your magazine is fine from cover to cover. But I don't believe everything I read.—F. W. S., St. Paul, Minn.

Want Locomotives, You Model Makers?

RECENTLY most of your model planes have been for woodworkers. How about something for metalworkers? I suggest working models of: N. Y., N. H., and H. R. R. locomotive No. 01; N. Y. C. locomotive, any T engine; N. Y. C. locomotives No. 1500 and No. 5000. I think any model maker would delight in their construction.—W. R., New York City.

Try This One on a Rainy Afternoon

THREE boys start on a canoe trip. Each has his own canoe and a certain amount of baggage. If B gave A all his baggage but thirty-five pounds, A would have twice the weight of C, but if B gave C one third of his load, C would have twice as much as he has now. However, if B left behind forty pounds and C left behind one half of his load, A's load

A *new* Service Policy that *definitely protects* your Car Investment

THERE are two important questions which should be answered satisfactorily before you buy any automobile. First, is the car so designed and built that it will give you the various qualities you have a right to expect? And second, have the manufacturer and the dealer made definite provisions to assure the car's continued fine performance for many years?

Both of these questions *can* be answered satisfactorily when you buy an Oakland Eight or a Pontiac Big Six. You can be sure that the car is built to high standards of quality. You can be sure that in performance, appearance, comfort and long life it represents outstanding value. And, thanks to the new Oakland-Pontiac Owner Service Policy, you can also be sure that your investment will be definitely protected.

This new service policy embodies many unusual features of value to every owner. It represents an extension of the fine service Oakland-Pontiac dealers render. It is handed to you in printed form, backed by both the dealer and the Oakland Motor Car Company, when your car is delivered. It contains the following specific provisions:

1—That your car will be delivered in first class condition, thoroughly inspected, adjusted and lubricated.

2—That all parts replaced under the standard warranty will be *supplied without charge as will the labor necessary for their installation* during the first 90 days or 4,000 miles, whichever occurs first. This service will be provided by any Oakland-Pontiac dealer in the United States upon presentation of your owner's identification card.

3—That during the initial driving period the dealer making delivery will give your car *two free* inspections and adjustments to assure its proper operation thereafter.

(a) At 500 miles the dealer will give your car a road test—check the oil in the engine, rear axle and transmission—and adjust the ignition, carburetor, timing and brakes.

(b) At 1500 miles he will give the car another road test and precautionary re-checking, performing the following operations: align the front wheels—tune the engine, adjust brakes, steering gear and fan belt—tighten all body and chassis bolts. In addition he will check the radiator, tires and lights—test and fill the battery—lubricate the car completely—all without cost except for the grease and oil used.

4—That the dealer will provide at regular 90-day intervals the 3-Point Free Adjustment Service—checking and adjusting ignition, carburetor and timing.

This liberal service policy definitely protects your investment. It enables you to enjoy, to the fullest extent and at minimum cost, the fine qualities of performance for which the Oakland Eight and the Pontiac Big Six are noted. And finally, it serves as concrete evidence of Oakland-Pontiac quality—for such a policy could successfully be applied only to cars in which the manufacturer has the fullest confidence.

OAKLAND MOTOR CAR COMPANY

Pontiac, Michigan

would weigh exactly as much as B's and C's together. What was the weight of each boy's load? I am sure it won't take your mathematical experts long to solve this one, but I'm interested in seeing how many do it right away, and I am particularly anxious to know exactly what form their solution takes.—H. O. H., North Tonawanda, N. Y.

He Wants to Set New Kite-Flying Record

IN A recent issue of POPULAR SCIENCE MONTHLY I noticed an article about kite flying which said that the unofficial record was twenty-two hours twenty-one minutes. Later another writer said he had kept up a kite for fifty-eight and one half hours. Somewhere else I saw a statement that two boys had kept a kite up for seventy-two and one half hours. Will someone tell me what the world's record for kite flying is? I am willing to try and break it.—J. T., Akron, Ohio.

Should Doesn't Make Does

I READ with interest the letter headed, "How Did He Know the Elephant's Age?" in your June issue. No one can give exact figures about the age of wild animals because their births and deaths, of course, are not recorded. There is this much known about an elephant: It takes him a long time to grow up and a long time to wear out. When well treated, an elephant should live to be a hundred years old. —N. B., Fostoria, Ohio.

Loves to Tinker So Builds Models

I HAVE been reading your magazine for about five years now and certainly enjoy each issue. I don't know what section I like most, but I love to tinker. I built a model of the *Sovereign of the Seas* and four toy submarines which I gave away to some boys.—G. E. C., Troy, N. Y.

Follows Instructions and All Goes Well

I HAVE tried with great success many of the ideas given in your magazine. Following instructions given in a recent article, I stippled my bedroom, giving it a very pleasing effect. I also successfully tried your article on bookbinding. The only change I made was in binding three volumes instead of six, as was suggested.

I have also made a clipping book of all the articles which are of interest to me and things which I want to make in the future.—J. E., Brockton, Mass.

Jordanoff Gives Him Urge to Fly

IN THE June issue of POPULAR SCIENCE MONTHLY, A. L. certainly doesn't know what he's talking about when he says reading Jordanoff's articles on aviation makes people afraid to ride in airplanes. They make me want to ride and pilot them more than ever.—L. L., Kynesville, Fla.

Believe It or Not, You Skeptics

I HAD an interesting experience the other day. While cleaning a fish, I discovered its heart still beating, although the fish appeared to be dead. I got a solution of warm salt water and applied one drop to the heart about every twenty seconds. The heart beat for forty-six minutes after having been removed from the fish. Has any other reader had a similar experience?—N. G., Leo, S. C.

You'll Find Out Before Long

I AM anxiously waiting to see who will win the $10,000 scientific achievement prize. I agree with W. E. T., Joliet, Ill., who hopes that some million-dollar corporation doesn't get it while a struggling individual inventor is overlooked. And of course this inventor might be hard to find.—J. B., Wheeling, W. Va.

Do You Puzzle? Sharks All Agree

I CERTAINLY can testify that L. D. L.'s problem of the boy's age is a terrible puzzler, but I think I have the right answer, notwithstanding. His brother was just three years old when the second boy was born and so No. 2 is nine years old now. Don't tell me I'm wrong because I'm sure I'm right. I must be. —H. N., Lodi, N. J.

The Dog Came Back, But How?

SPEAKING of dogs and cats, here's one for the book and, by heck, it's true! Thirty-five years ago there was a station agent named Crosby at Pipestone, Minn. He sold his Irish setter to a hunter from Wisconsin. The dog was put in a crate and shipped to his new home east of the Mississippi. A few days later Crosby got word that the dog had run away. Three weeks later, the setter staggered into the little wooden station at Pipestone. He was at the point of exhaustion and nearly died. With good care he recovered, but the strain of his long trip so weakened him that he went blind. It's a pleasure to add that Station Agent Crosby took excellent care of that dog as long as he lived. Now what do you think of that? Put that up against any stunt pulled off by a carrier pigeon or a rabbit-minded cat. What? My hat's off to dogs, and I've known a lot of them during a long life.—R. S., Pipestone, Minn.

Good Advice for Brick Throwers

I HAVE been a subscriber to POPULAR SCIENCE MONTHLY for two years and I keep every copy, as it makes the best reference library I know of. Go ahead printing it just as you have been, and let the "brick throwers" get something else if they don't like it—and can find anything nearly as good.—H. K. M., Yakima, Wash.

Extraordinary, but Is It New?

REFERRING to the three-square box in which the numbers add to a given quantity, in this case fifteen, I have developed a key by which I can make the numbers add up to any given quantity. I don't suppose I've done anything new, but I feel elated over it because I can puzzle my friends with this trick. Have I done anything extraordinary? Or have I merely discovered something as old as the hills?—V. C., Brooklyn, N. Y.

Gus Gets It Right Between the Eyes

SAY, you. Tell Gus to keep his eyes on the road ahead when the signal light says "Go." Here he is giving us a lot of good advice about autos, but seems inclined to chew the rag with the guy behind him about his pretty horn when the business ahead is liable to prove urgent. Don't you really think Gus should set us mere drivers a good example, since he seems to know a car backwards?—B. D. A., Mena, Ark.

Stagecoach Model Delights Him

I HAVE just built a stagecoach model from Mr. Love's plans. In my model everything works in every detail and it is built entirely of copper, brass, and wood. I got an effective coloring with yellow wheels, the base of the body green, and the upper panels yellow. In all, it makes a handsome and striking model and I am well pleased with it and take great pleasure in showing it to my friends.—R. D. S., Norfolk, Va.

How Many Built Boats Like This One?

I CAN hardly say which article interested me most in the June issue, but I want to tell you that I built a boat from the plans in the March and April issues. This is my first experience in boat building and the boat hardly leaked when first launched and now is entirely dry and handles perfectly with five persons. I am using a Neptune twin-cylinder motor and it gives wonderful service. Am wondering how many of these boats were built from your plans and how the builders got along.—A. C. W., Moberly, Mo.

Did Science Scoff at Attempts to Fly?

REFERRING to your July editorial, "Take a Backward Look." Let's go yet further back. In the late Sixties, a leading scientific magazine showed various attempts at flying, but finally, as I dimly remember, it dismissed the idea with an editorial disclaiming any expectation, or even the desirability, of success. These sixty-odd years may have tangled my ideas, but am sure there was something along this line, and it might be well worth digging up.—W. S. R., Cottage Hill, Fla.

Department about Fish Requested

I ENJOY your magazine immensely. I can't wait until the first of the month comes around. There is one suggestion I should like to make: I think on account of the growing interest in aquariums and tropical fish, that you should have a department in your magazine devoted to this subject.—J. R. S., New York, N. Y.

Nuisance No. 566 . . .

Good looking. Bright. Aggressive. He came to the company from a Boston firm where he had made an enviable sales record for three years. He expected to do great things in his new position; the proposition was a winner, appealing, easy to sell, profitable to him. But from the outset things went badly. Scarcely had he opened with his cheery "Good morning, Madam," than he found the door closed in his face. They simply wouldn't listen to him. It was a new and bitter experience for him, and he couldn't explain it.

Business men *can't afford* to overlook this matter

The insidious thing about halitosis (unpleasant breath) is that the victim himself rarely knows when he has it. And even his best friends hesitate to tell him.

Clearly, such a condition is a distinct drawback to progress in business, professional or social life. Common sense and an instinct of ordinary decency suggest that every possible step be taken to put the breath beyond suspicion.

One certain way to accomplish this is to rinse the mouth with full strength Listerine, the safe antiseptic, every morning, every night, and between times before meeting others.

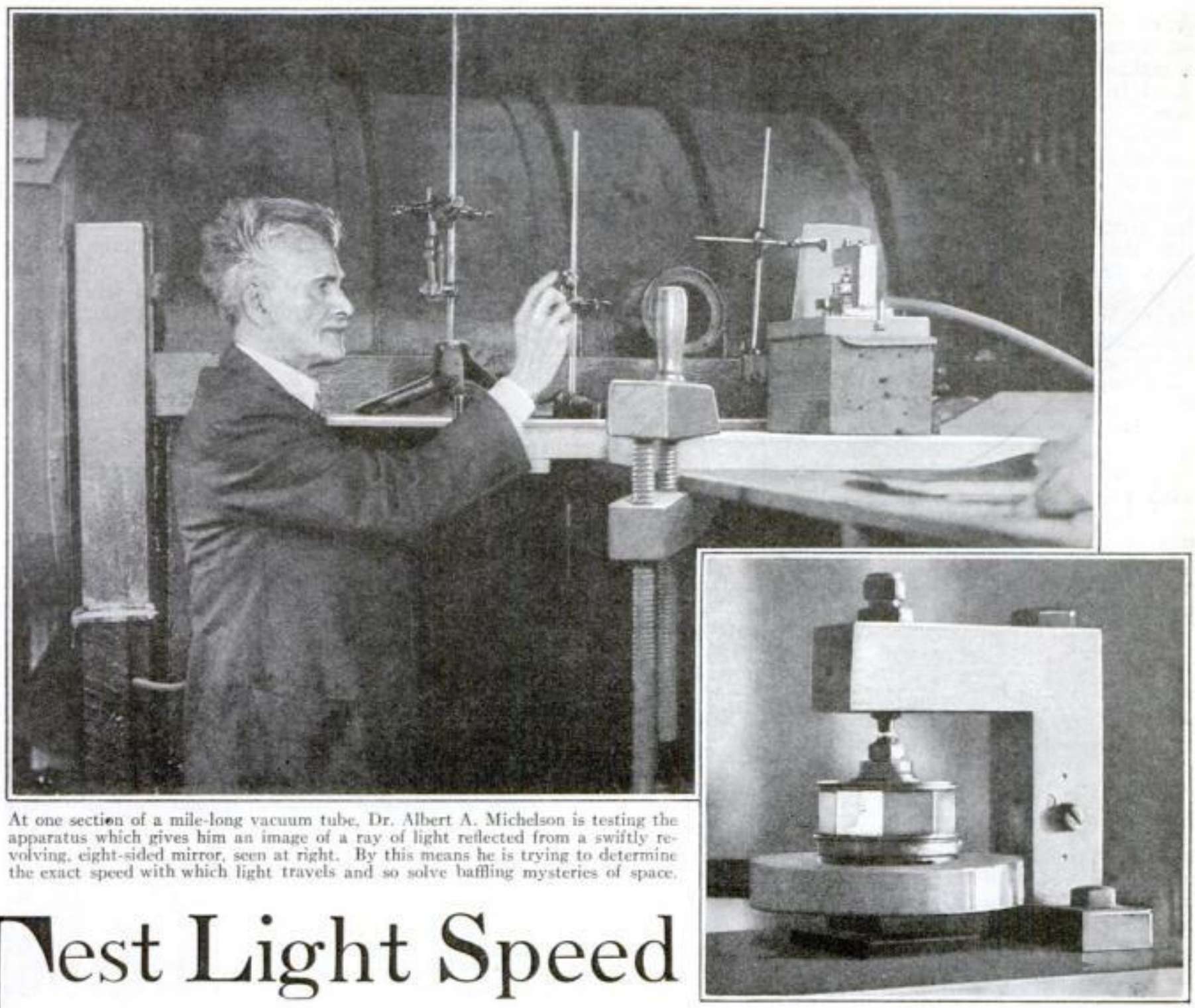
Listerine instantly conquers halitosis because, being a germicide*, it halts food fermentation and checks infection—each a cause of odors. Then, being a powerful deodorant, it swiftly overcomes the odors themselves. Lambert Pharmacal Company, St. Louis, Mo., U. S. A.

*Though safe to use in any body cavity, full strength Listerine kills even the Staphylococcus Aureus (pus) and Bacillus Typhosus (typhoid) germs in counts ranging to 200,000,000 in 15 seconds (fastest time accurately recorded by science).

LISTERINE *ends* halitosis

Popular Science MONTHLY

SEPTEMBER, 1930 RAYMOND J. BROWN *Editor* VOL. 117, NO. 3



At one section of a mile-long vacuum tube, Dr. Albert A. Michelson is testing the apparatus which gives him an image of a ray of light reflected from a swiftly revolving, eight-sided mirror, seen at right. By this means he is trying to determine the exact speed with which light travels and so solve baffling mysteries of space.

Test Light Speed In Mile Long Vacuum Tube

By H. H. DUNN

HIDDEN in a mile-long pipe, laid on the flat floor of a southern California valley, lies the yardstick of space beyond the stars, and, in the minds of a number of astronomers, the solution of the problem of communication between the earth and the other planets. Whirled 512 times every second, a small, eight-sided mirror, highly polished, is trying to pull from that pipe a single fact which, once established, will enable astronomers, physicists, and surveyors to do many new and amazing things in their respective fields.

The mystery to be solved is the *exact* speed of light. Dr. Albert A. Michelson, world-famous physicist, now retired from the faculty of the University of Chicago, but working under its auspices and those of the Carnegie Institution, is the man at the mirror. His present calculation, made in 1926, is that light travels 186,284 miles a second; but he also believes that there is an error of 18.62 miles per second in that figure.

In such tremendous speed, this seems a small error, but in the calculation of the distance of a star whose light has required, say, 1,000 years to reach the earth, it becomes considerable.

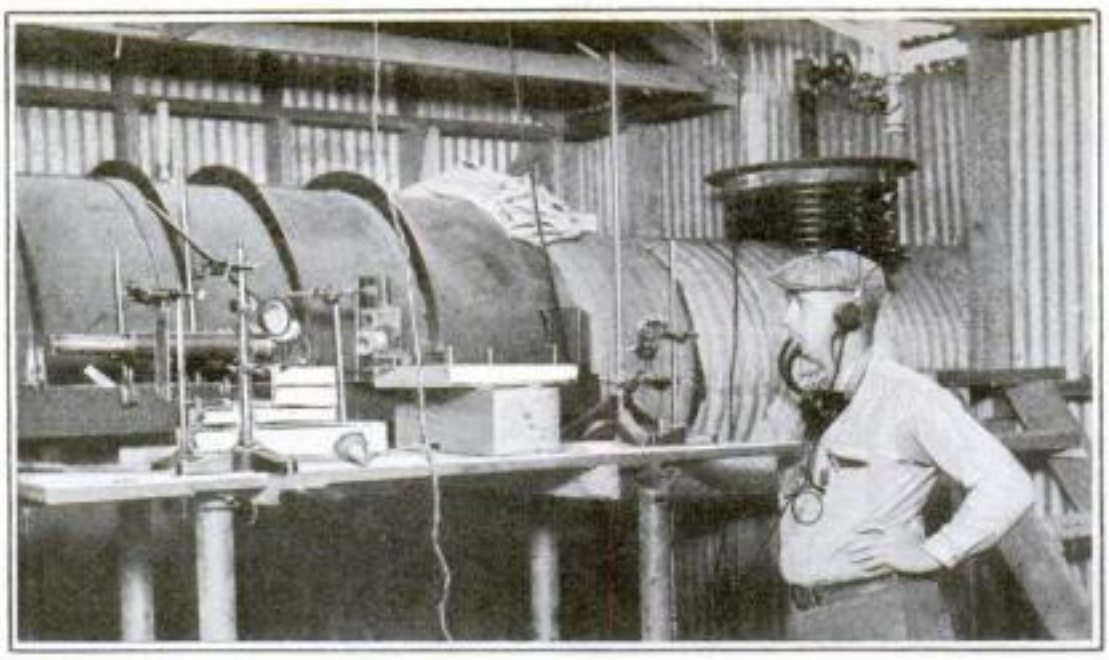
WHEN Doctor Michelson has established the exact speed of light by the methods to be described later, he will have placed in the hands of astronomers, physicists, and civil engineers an absolutely accurate implement. With this new tool, constant throughout space, astronomers will be able to measure exactly all celestial distances and map the heavens to the most distant star whose light has reached the earth. Guesswork and approximation in making astronomical measurements will be abolished and the movements of the heavenly bodies then may be charted with absolute accuracy.

By the use of a fused-quartz reflector and a Sperry arc light, with the knowledge of the exact speed of the beam sent out by

this equipment, it is believed that the chances of interplanetary communication will be tremendously enhanced. However, as Doctor Michelson said to the writer, "communication with the other planets, supposing that there is intelligent life on them, becomes not so much a problem of making the signals as of interpreting them."

In the speed of light also lurks proof or disproof of the Einstein Theory, particularly that part which deals with the curvature and limitation of space. This, also, is for the astronomers to develop. Further than this, a knowledge of the exact speed of light may assist in determining the perplexing question of the mysterious ether.

The usually accepted theory gives to light an undulatory wave. If this be correct, that wave must have some medium in which to move. If there is no such thing as ether, in what medium does light move when it has passed beyond the atmosphere of the earth? If, on the other hand, we are to accept the theory that light consists of a series of minute projectiles, then, of course, it requires no medium in which to travel, and the ether theory, in so far as light is concerned, may be dropped.



A. M. Beebe, of the engineering staff of Mt. Wilson Observatory, is getting the gigantic vacuum tube ready for the Michelson experiments to discover accurate speed of light.

TO the physicist, Doctor Michelson will be presenting, when he has established the speed of light, an entirely new instrument for the analysis of the atom.

For practical purposes, on this earth itself, the true speed of light may be of the greatest value in long-distance surveying. When that constant factor is determined, a beam of light, shot into the darkness, might be made to measure the distance across mountain ranges, gorges, lakes, or deserts, without the time-consuming necessity of chaining the miles.

In this way, it could be of great value to the Coast and Geodetic Survey, for example, in its work of mapping the land and charting the sea. This new surveying would be from mirror to mirror, instead of from transit to rod as now conducted. Knowing the exact time required for a beam of light to traverse any distance, and knowing the exact speed of light in air or in vacuum, it would be a matter of comparatively simple mathematical calculation to establish the distance any particular beam has traveled.

This mile of corrugated iron pipe, the longest vacuum tube ever made by man, is three feet in diameter, literally an inclosed path for a ray of light. Its walls are one sixteenth of an inch thick, and the pipe alone weighs ninety-nine tons. With the tanks for the mirrors and other instruments, one at each end, it weighs approximately 105 tons.

The tube rests about four feet from the ground on 440 wooden cradles, with a deeply-bedded I-beam truss every quarter of a mile and at each end. There are eighty-eight sections, each sixty feet long, bound together with 270,000 rivets, and further sealed at each joint with cement paint, overlapped by strips of inner tubing.

THE tube, tanks, mirrors, motors, pumps, and other equipment cost, complete, more than $50,000. It is straight, but not level, since there is a drop of about three feet to the mile between the south, or control, end, and the northern terminus.

Doctor Michelson and his assistant, Dr. Fred Pearson, research assistant at the University of Chicago, with Dr. Francis Pease, astronomer at Mount Wilson Observatory, expect to be occupied with these experiments on the speed of light from four months to two years. After that the huge tube, which stands on land loaned by James Irvine, will be used for experiments with gases and probably with tests of ether drift.

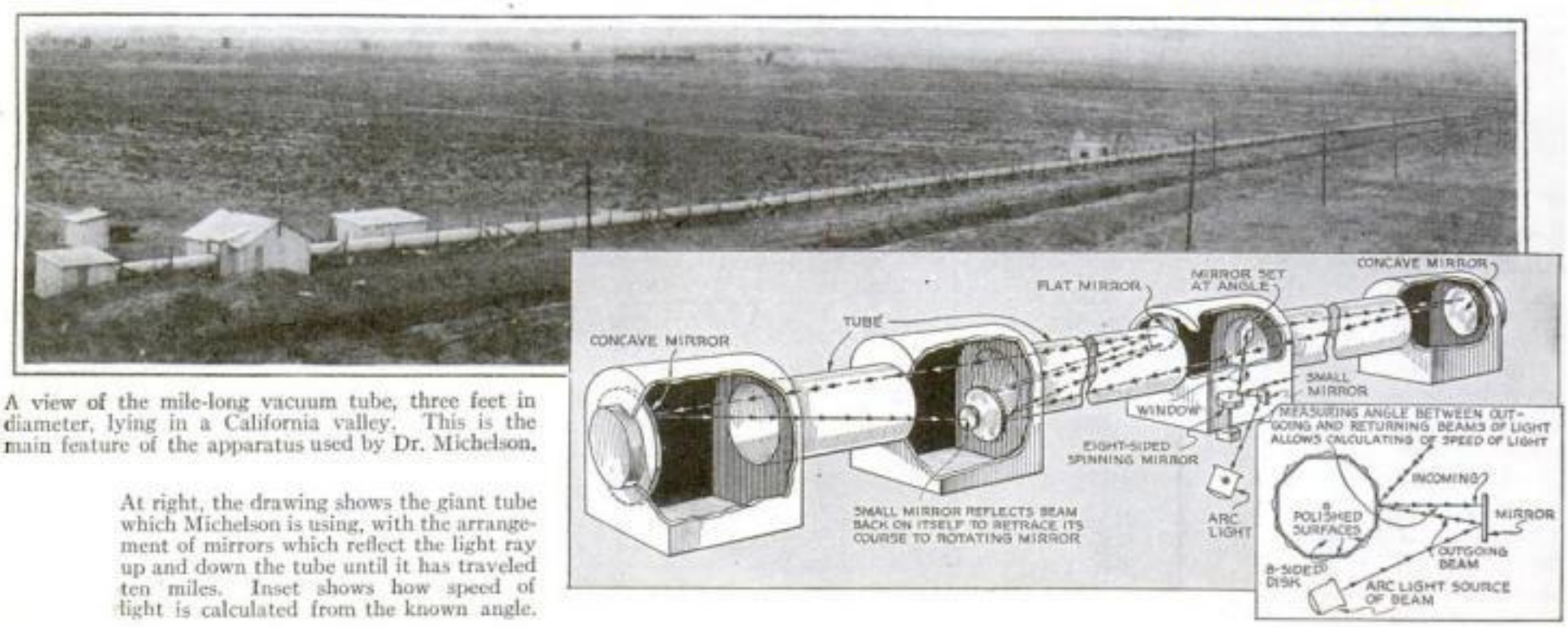
Doctors Pearson and Pease made all the preliminary preparations on the unusual and delicate optical system which the tube contains and on whose accuracy depends the value of the results of the experiments with light. E. C. Nichols, designing engineer of the Mount Wilson Observatory, did all the engineering work on the tube.

THE great pipe, looking more like a conduit for irrigating waters than anything else, contains 40,000 cubic feet of air. This has been exhausted to about ten millimeters of vacuum, for two reasons: First, to establish as nearly as possible the conditions in which light moves in space; and, second, to eliminate the dispersion and "shimmer" of light beams when projected into air.

At either end of the tube is a small house, also of corrugated iron, the one at the south end being the main control with a complicated series of switches for operating the motors, pumps, and other equipment, and the one at the north end being a similar but less important control station. At the south end a five-inch tube, closed at the outer extremity, with heavy but very clear plate glass, is let into the vacuum tube, to permit the passage of the beam of light to the mirrors inside.

In this small room, not more than twelve by fifteen feet in size, Doctor Michelson and his assistant, Doctor Pearson, will determine to the ultimate exactness possible the great constant of all the universe—the speed of light. Created by an ion arc, a small but power-

(Continued on page 132)



A view of the mile-long vacuum tube, three feet in diameter, lying in a California valley. This is the main feature of the apparatus used by Dr. Michelson.

At right, the drawing shows the giant tube which Michelson is using, with the arrangement of mirrors which reflect the light ray up and down the tube until it has traveled ten miles. Inset shows how speed of light is calculated from the known angle.

Radio City To Cost $250,000,000

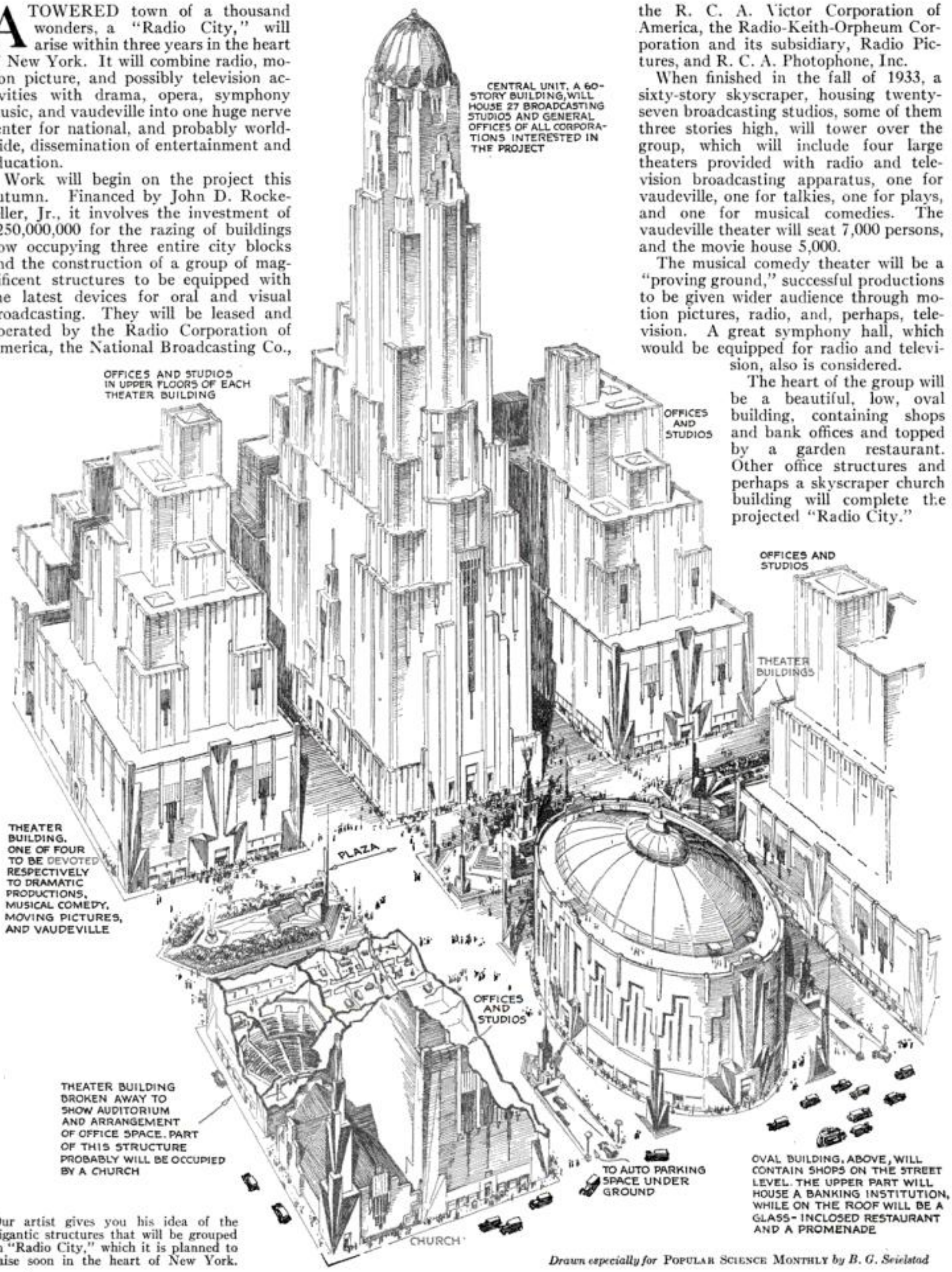
A TOWERED town of a thousand wonders, a "Radio City," will arise within three years in the heart of New York. It will combine radio, motion picture, and possibly television activities with drama, opera, symphony music, and vaudeville into one huge nerve center for national, and probably world-wide, dissemination of entertainment and education.

Work will begin on the project this autumn. Financed by John D. Rockefeller, Jr., it involves the investment of $250,000,000 for the razing of buildings now occupying three entire city blocks and the construction of a group of magnificent structures to be equipped with the latest devices for oral and visual broadcasting. They will be leased and operated by the Radio Corporation of America, the National Broadcasting Co., the R. C. A. Victor Corporation of America, the Radio-Keith-Orpheum Corporation and its subsidiary, Radio Pictures, and R. C. A. Photophone, Inc.

When finished in the fall of 1933, a sixty-story skyscraper, housing twenty-seven broadcasting studios, some of them three stories high, will tower over the group, which will include four large theaters provided with radio and television broadcasting apparatus, one for vaudeville, one for talkies, one for plays, and one for musical comedies. The vaudeville theater will seat 7,000 persons, and the movie house 5,000.

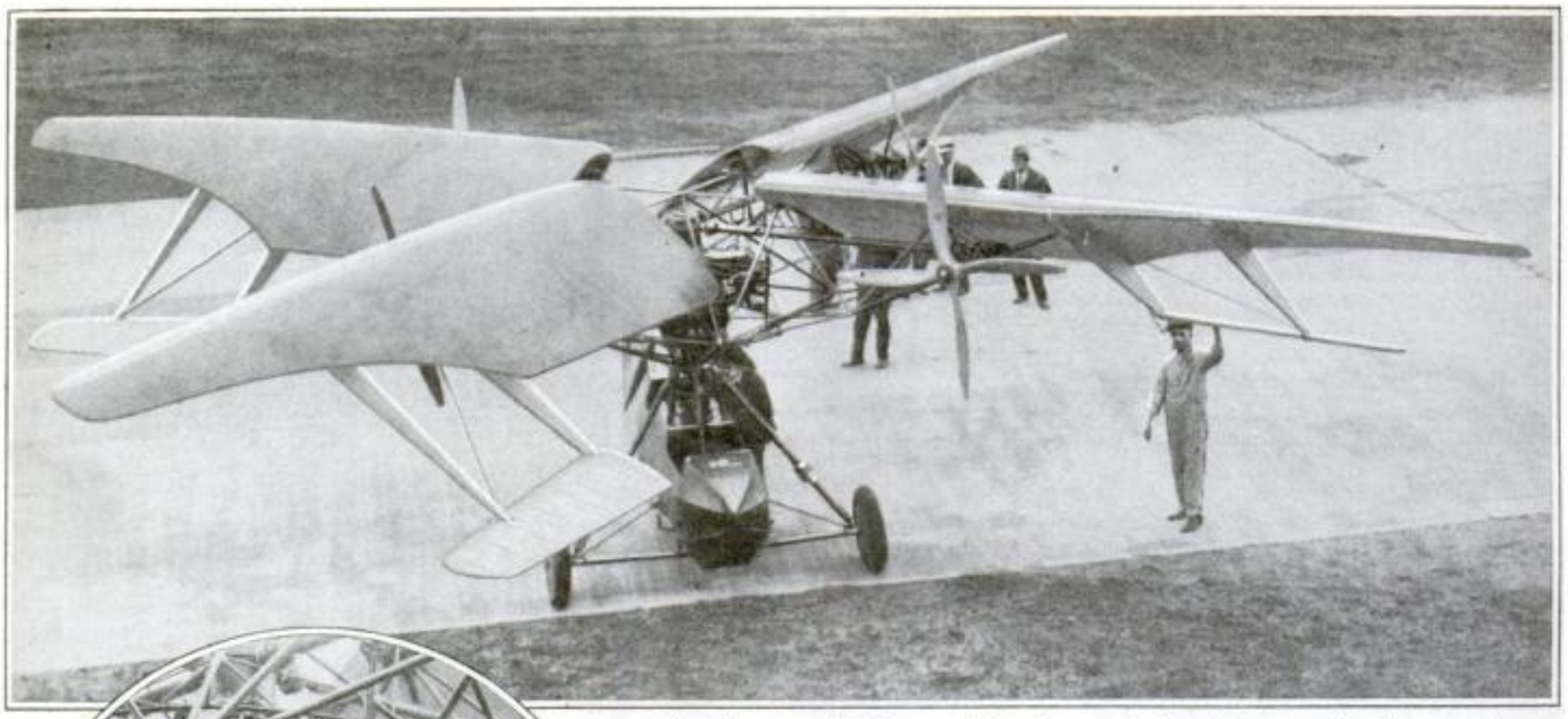
The musical comedy theater will be a "proving ground," successful productions to be given wider audience through motion pictures, radio, and, perhaps, television. A great symphony hall, which would be equipped for radio and television, also is considered.

The heart of the group will be a beautiful, low, oval building, containing shops and bank offices and topped by a garden restaurant. Other office structures and perhaps a skyscraper church building will complete the projected "Radio City."



Our artist gives you his idea of the gigantic structures that will be grouped in "Radio City," which it is planned to raise soon in the heart of New York.

Drawn especially for POPULAR SCIENCE MONTHLY *by B. G. Seielstad*



This helicopter, with four revolving planes, each drawn by a propeller, has met all the ground tests and is expected to rise in vertical flight a thousand feet in a minute.

Maitland B. Bleecker seated in the cockpit of the straight-up aircraft that he invented and which may revolutionize flying.

New Plane May Fly Straight Up in Air

By EDWIN W. TEALE

FROM a closely-guarded hangar at Curtiss Field, Long Island, N. Y., workmen recently wheeled a weird-looking flying craft which resembled a gigantic forty-seven-foot windmill. It was the Curtiss-Bleecker helicopter, a $250,000 experimental machine which took four years to build.

If it fulfills the expectations of the Curtiss engineering staff, which produced the "Tanager," the winner of the Guggenheim Safe Aircraft Contest, and many other famous planes, it will make vertical flight possible, and will turn back yards into air fields.

Four silver-and-yellow twenty-foot wings are mounted on the framework above the blue underslung body of the machine. Each wing is pulled by a four-bladed propeller spinning in front of it. When the helicopter is in operation, the four wings, like four separate airplanes, chase each other around in a circle, the angle at which the wings are set making the whole a monster air screw dragging the machine aloft.

While the wings are not fixed on their horizontal axes, small control surfaces, called "stabovators," mounted several feet behind them, determine the angle at which they meet the air. These movable surfaces raise and lower the rear edges of the wings much in the manner of ailerons.

In the cockpit, at the nose of the streamlined body, the operator handles regulation airplane controls. A vertical stick, connected to the stabovators, can be moved ahead, back, or to either side. This allows the revolving wings to be tilted in any direction to pull the machine horizontally as well as vertically. The foot pedals in the cockpit, instead of being connected to a rudder which swings from side to side, are hooked to a "spin vane" at the rear of the stubby body. This vane rotates on a horizontal axis. When it is tilted to one side, the air driven down by the wings above spins the car around facing the direction the pilot desires.

THE weight of the machine empty is approximately 2,800 pounds; fully loaded, 3,400 pounds. Its total supporting surface is 370 square feet.

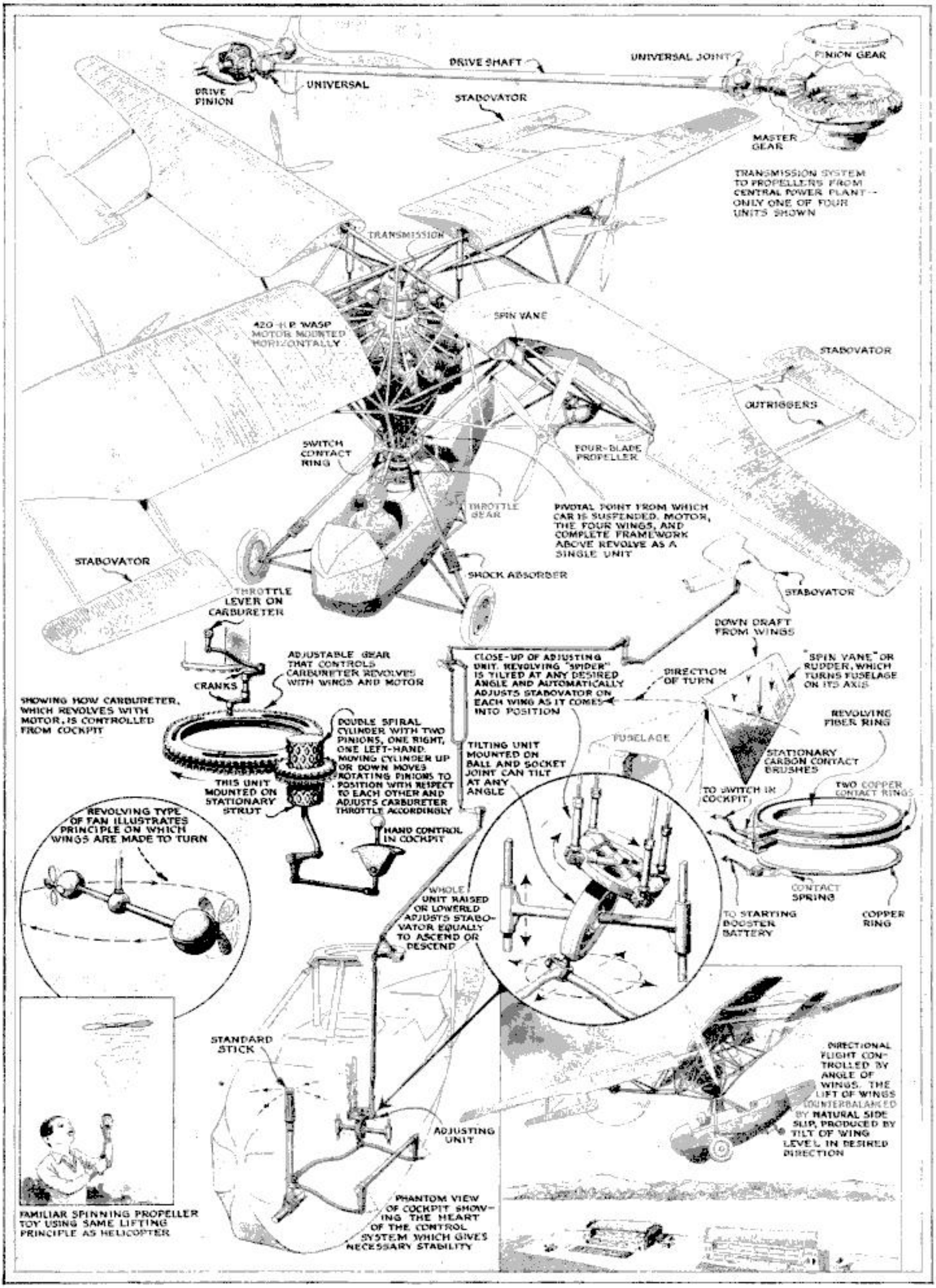
A single Wasp 420-horsepower air-cooled engine is mounted horizontally above the fuselage. Through shafts and gears, it furnishes power to each propeller. At flying speed, the engine turns 2,100 revolutions a minute while the geared-down propellers whirl at 1,530. When the four wings are circling at sixty revolutions a minute, the machine is designed to leave the ground. At top speed, the wings revolve approximately 100 times a minute.

The designer of the curious craft is Maitland B. Bleecker, twenty-seven, a graduate of the aeronautical engineering classes at the University of Michigan and formerly a junior aeronautical engineer for the National Advisory Committee for Aeronautics at Langley Field, Virginia.

THE original principles of the machine were evolved by Bleecker when he was a student in Michigan. Many unsuccessful helicopters have been built in the past. While they showed such machines can get off the ground, they lacked control. By his stabovators, Bleecker believes he has overcome this problem.

During its first trial, the craft passed its ground tests successfully, but a leaky oil line prevented further demonstrations. If subsequent tests prove it has the desired flying qualities, it will be capable of rising a few feet above the floor in the hangar, flying out the door, and then mounting straight into the sky at the rate of 1,000 feet a minute. Its speed in any direction will be seventy miles an hour and it can hover over one spot as long as its thirty gallons of fuel lasts and then descend like an elevator, landing on a spot no larger than the machine itself.

A take-off and a landing may be made from the roof of an ordinary building; and if the motor stops, the inventor says, the machine will settle at a speed no greater than that of the airplane parachute.



Will this strange Curtiss-built airplane fly? Study the above drawing and decide for yourself. Note particularly the stabovators, which are expected to direct the line of flight either straight up in the air or horizontally at the will of the pilot.

This drawing shows how the four propellers are powered by a single 420-horsepower Wasp motor and also how the directional flight is controlled by the angle of the wings. Note revolving fan in the circle at the left which shows principle of new machine.

Secrets of Sleep Revealed by the Camera

Experiments conducted by the authors of this article answer most of the questions you have asked yourself about sleep. Photos automatically taken of sleeping persons give new, unusual facts.

By

H. M. JOHNSON *and* G. E. WEIGAND

IS "SLEEPING like a log" more restful and a sign of better health than tossing about in bed? How often does the average healthy person change his position during a night's sleep? What postures does he assume? How long does he hold each position and which does he prefer? What kind of bed is most likely to produce a good night's rest?

Definite answers to these and other questions concerning sleep, which have puzzled physicians and laymen for many years, have been found through elaborate tests conducted by the Simmons Investigation of Sleep at the Mellon Institute of the University of Pittsburgh.

The investigation extended over a period of five years. In that time, observations were made of the sleeping habits of more than 150 persons of both sexes and varying ages. Each of the subjects was studied nightly for at least several weeks. More than a million separate observations were taken into account. Since last summer, the observations have been made by means of a novel and ingenious photographic method.

The general belief among physicians and the public at large is that a healthy sleeper, if left to follow his own inclinations, will ordinarily take some one posture and occupy it for several hours without making any great changes in it.

This assumption the investigation has shown to be wrong. From the mass of information gathered, these two important facts stand out:

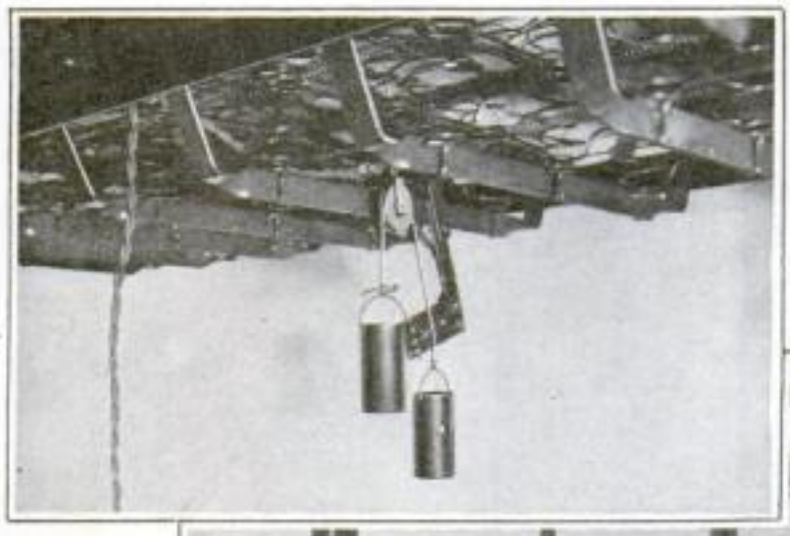
First, it is abnormal for a healthy sleeper to lie in one position for a long time; frequent changes of posture are inseparable from healthy sleep.

Second, the average healthy sleeper changes his position thirty-five times during an eight-hour night.

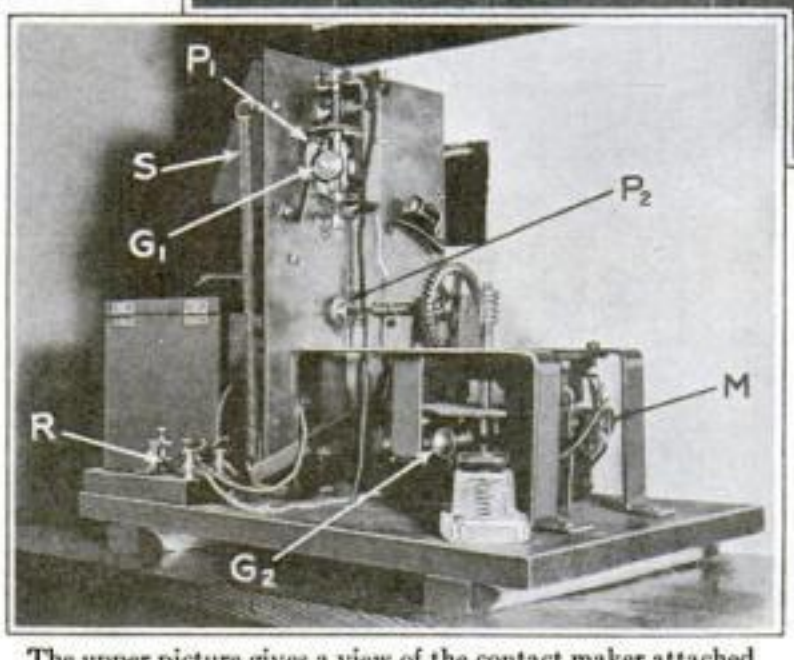
Why all this tossing and turning? Our study of the various poses assumed by the average sleeper showed that a number of them are adapted to relieve the strain in muscles, tendons, and joints caused by postures that were held for long periods during the day. Others obviously serve to relieve the muscular strain produced by positions that precede them during the night. This was apparent from the order in which they occurred.

The normal sleeper, we found, moves his body into a different position between twenty-five and fifty times in a night of eight hours, at intervals of five minutes or more. There are, of course, differences between individual sleepers; the most restless of our healthy sleepers stirred more than three times as often, on the average, as the most quiet individual. Also, the same person may stir twice as often on a restless night as he does on a quiet night.

The average was found by gathering sufficient facts about each person. Our most typical subject, on his most typical night of eight hours, changed his position in thirty-five of the ninety-six five-minute intervals that compose the night. About seventeen of these postures he held for five minutes or less; about seven, for more than five and less than ten minutes; about four, for ten to fifteen minutes, and so on. He sometimes held one position for as long as one hour, but not every night.



Motion picture cameras outside the bedroom in front of peepholes clicked as sleeper moved.



The upper picture gives a view of the contact maker attached to springs and operated by movement of the sleeper. Immediately above, the driving mechanism of the camera, behind the upright panel, by means of which the photos were taken.

These results were obtained through a method originated by the Austrian physiologist, Dr. J. S. Szymansky. A recording instrument was attached to the bed. Each time a sleeper changed his position, a pen in the device recorded his movement on a chart, on which was also marked the time at which each change was made. By deciphering the chart we could tell how long each position was held.

This method established the fact that healthy sleep and frequent changes of position are inseparable. It also enabled us to discover and study a variety of factors

In this and other views, sleeper moved without waking. Posture was held for one minute.

This "kitten-coil," a favorite with healthy sleepers, was held for seventeen minutes.

This looks comfortable, but the sleeper held it only two minutes and then turned on his side.

that influence these changes. But it did not show what posture was held at any one time, or what posture preceded or followed it. To get the additional information, we used photography.

We would have liked to make the pictures by invisible or ultra-violet light, so that we could have obtained the photographs without requiring our subjects to sleep in the light. But we feared that continuous exposure to enough ultra-violet light to make photography possible might injure the sleepers' skins. Moreover, it was not easy to provide an ultra-violet flashlight or a screen that would let nothing but ultra-violet rays pass.

We therefore decided to use an ordinary lamp of 100 or 150 watts, hung directly over the bed. To reduce the disturbance, we had the subjects wear a dark taffeta ribbon over their eyes, but after two or three nights they usually discarded it. They learned something that we already knew—that light, of itself, does not interfere with sleep.

To show clearly the position of arms, legs, head, and trunk, it was necessary to dispense with blankets. A sleeper who can control his bed covering, we previously had found, establishes in a fairly short time a "tropical climate" in the air pockets about his skin. By means of a device automatically controlling the heating apparatus, we maintained the room temperature between seventy-eight and eighty-two degrees Fahrenheit, which permits the skin temperature to be kept several degrees higher by a choice of suitable night clothing.

THE views were taken with a motion picture camera. If we had run the camera continuously, it would have required about five and a half miles of film for each night! But Professor Starke R. Hathaway, of Ohio University, a member of the investigation, designed a device that gave us just as much useful information on seven or eight feet of film.

How did it work? A two-point contact maker was mounted to the rigid frame of the bed spring. This contact maker was controlled by an apparatus which was operated by the movements of the sleeper and which consisted of two heavy weights attached to both ends of a cord running over a pulley. The contact maker could close an electric circuit in response to either an up or down motion.

THE camera itself was mounted outside the sleeping chamber in front of a small peephole in the wall. Whenever the sleeper changed position the resulting electrical contact caused the camera to take a picture. Then the driving mechanism of the camera itself took another picture, one minute later. As long as the sleeper did not stir, after this second picture, nothing happened. When he stirred again, the process was repeated.

The pictures taken at contact show when the sleeper abandoned the previous position, because they include a clock placed beside the bed. The others show the new position assumed. We know that the posture shown in the second picture was assumed exactly one minute before the time shown by the clock. We also know that it was abandoned at the time shown in the next contact picture on the strip. Thus we can tell, within one second, how long each posture was maintained.

The driving mechanism on the camera was worked by a spring which a motor rewound in one minute. Each time the spring was rewound a picture was taken. If the sleeper stirred during the rewinding, the electrical device, operated automatically by the contact-maker, released the spring and started it rewinding all over again without taking a picture.

The camera's (Continued on page 130)

Here is another variation of the kitten coil, and in this case the sleeper held the pose 19 minutes.

Almost the same as above except the sleeper is now on his left side. Held for 15 minutes.

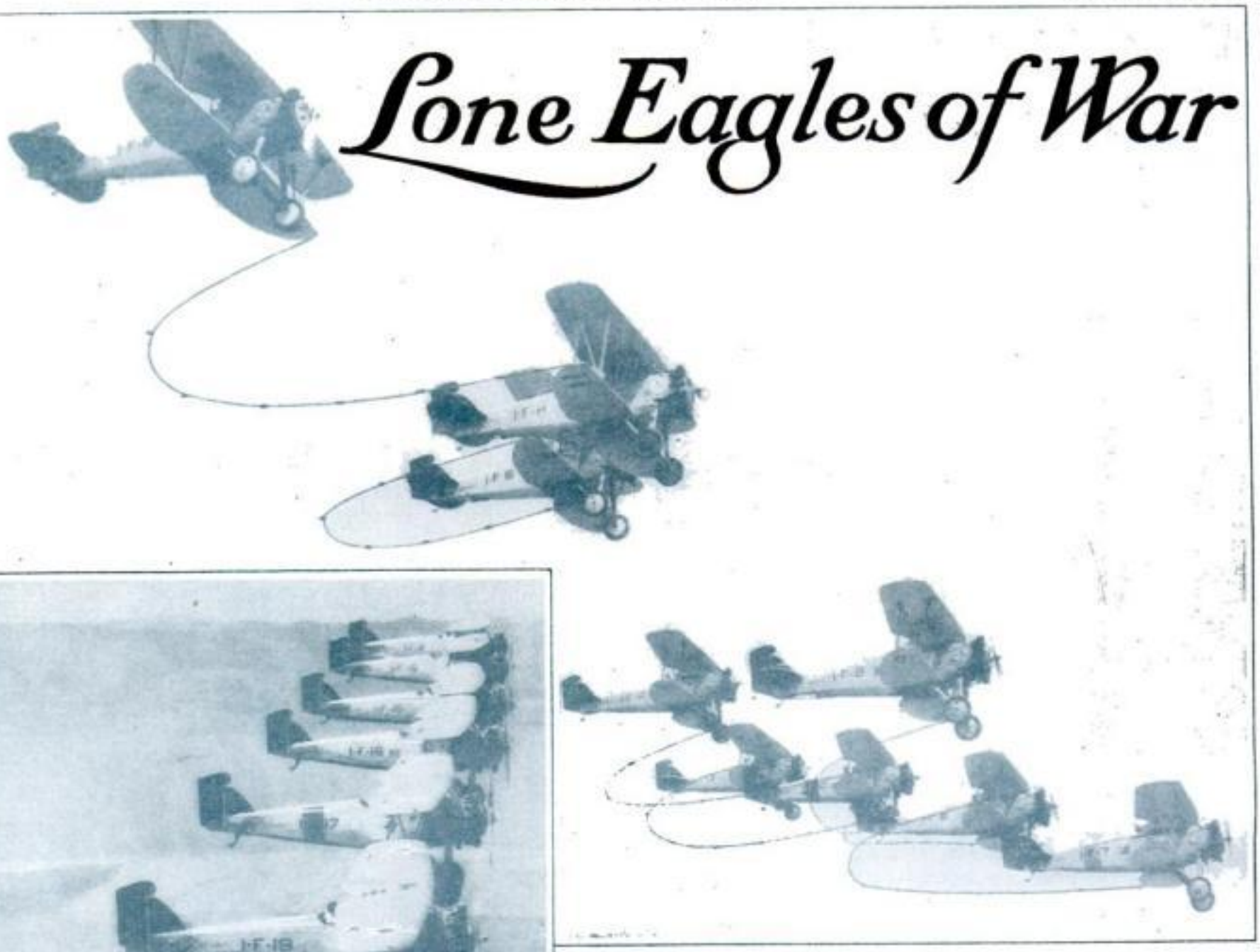
On his back again and apparently comfortable, for he remained lying thus for 41 minutes.

Still on his back, the sleeper has returned to the pillow. But this posture did not suit him and in two minutes he took another photo of himself.

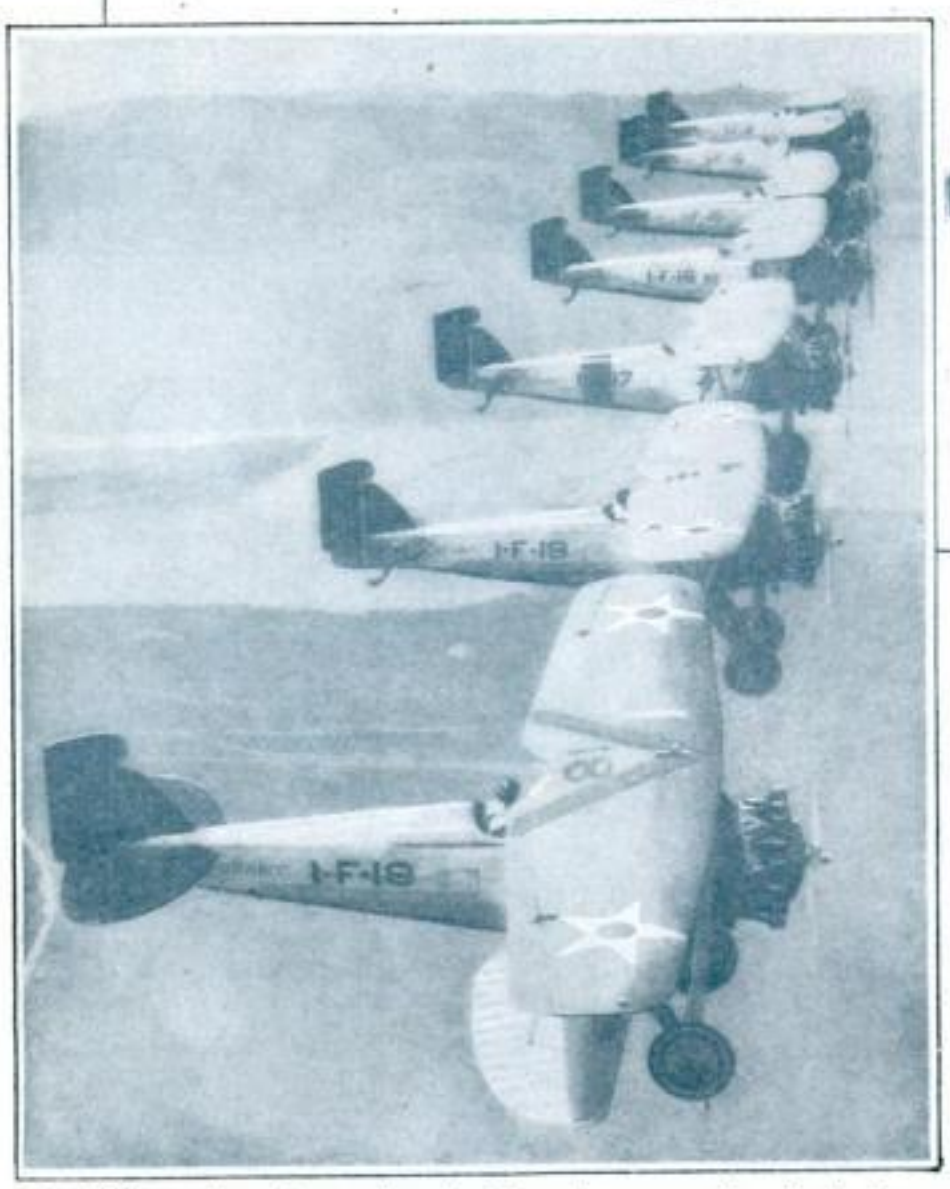
In this pose the sleeping subject has abandoned the pillow and is almost, but not quite, flat on his back. Seldom does a sleeper lie fully supine.

In this picture it is obvious the sleeper needs the bed to himself and could not assume this posture, held for 26 minutes, in narrower bed.

Lone Eagles of War



Lashed together with half-inch rope, Navy planes do difficult stunts in the air, such as looping the loop, without breaking their connecting lines.



In solid formation, wing to wing, the Navy planes roar through the sky. Each plane executes any maneuver signaled for by the squadron leader.

By LIEUTENANT H. B. MILLER

Flight Instructor, U. S. Navy

THUNDERING motors of eighty Navy airplanes recently roared through the clouds over the skyscrapers of New York. From the crowded streets below, it looked as if wing tip touched wing tip as the planes, flying in formation scarcely thirty feet apart, hurled earthward in power dives of a thousand feet and circled and banked in perfect alignment.

A few weeks before, out on the Pacific Coast, more than 150 Army and Navy planes paraded past the reviewing stand only a few hundred feet from the ground, flying so close together that they seemed one continuous gigantic airship. This in 1930. In 1910, four planes in the air at once at a Chicago aviation meet were thrilling grist for the headlines. World War "dog-fights" in which squadrons hurled themselves at each other brought the dawn of formation flying.

In the early part of the conflict, planes went out on individual forays. Here the skilled flyer who was an expert gunner was at his best. Depending on the temperament of the pilot and the performance of his machine, he could accept combat with an enemy or maneuver to avoid it.

René Fonck, ace of aces of the Allies with a record of seventy-five planes downed, was one of the clever, patient type who waited for his enemy to disclose a weakness. Like a flash he took advantage of that instant to attack. Nor did he hesitate to draw off from an adversary who proved to be a master. Proof of his wisdom lies in the fact that not until his thirty-second enemy had been brought down did his plane receive so much damage as a bullet hole!

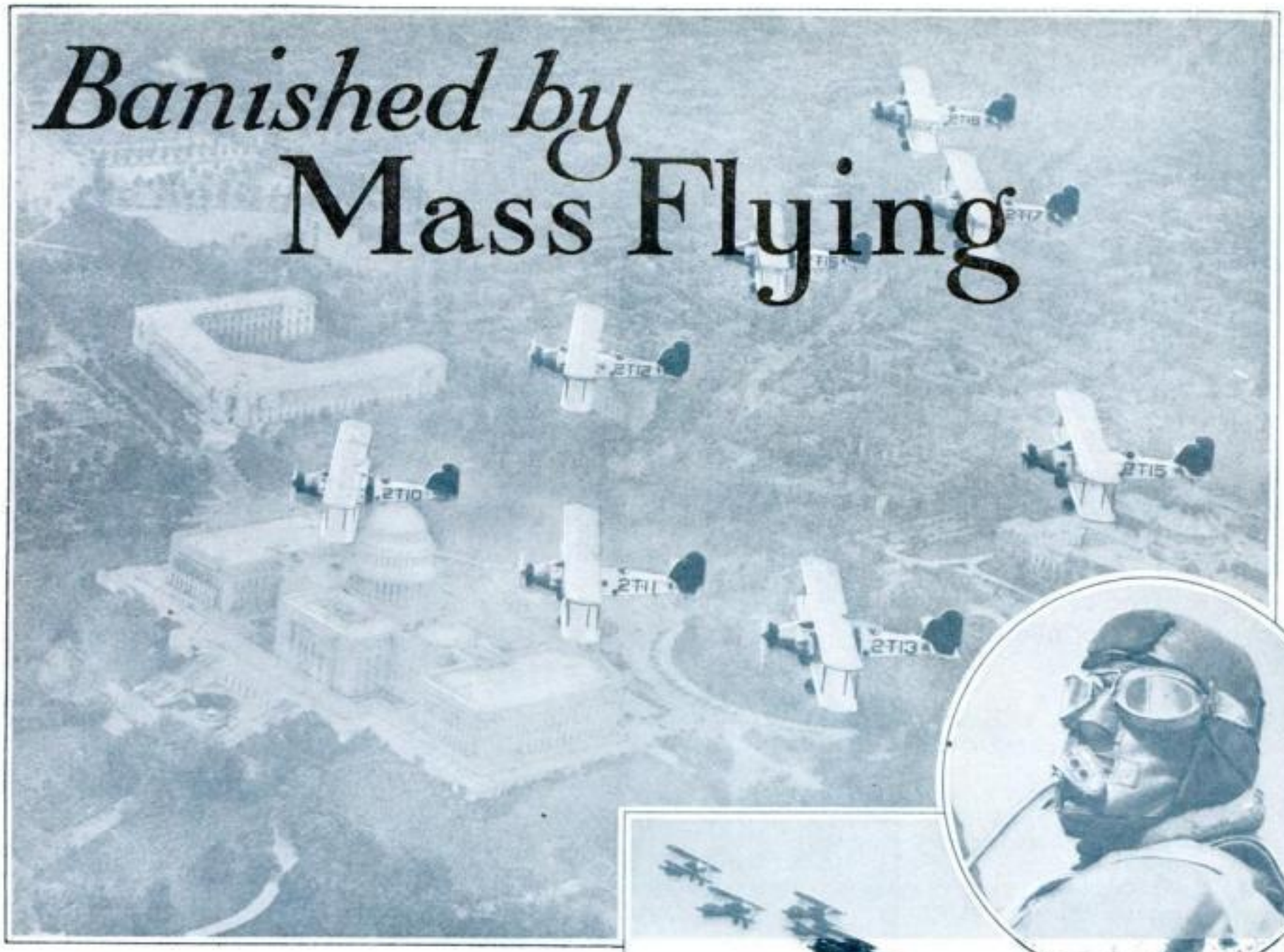
Georges Guynemer, French ace with fifty-three victories to his credit, was the impetuous type who knew that death was inevitable but who was going to make the enemy pay dearly for his life. Even after fighting planes flew in groups, he never hesitated to attack. In one instance he, single-handed, dove on eight planes and succeeded in destroying two of them before he withdrew from the resulting mêlée.

As the airplane developed into a distinct fighting machine, it began to lose its early glamour and mystery. It became a practical and indispensable unit of a fighting force. Sound tactics were evolved. The age-old maxim that the general who could mass his troops in superior numbers against the enemy should win was adopted.

Frequently, two aviators would combine in applying their own system of strategy. One would act as a decoy while the other lay in hiding higher up or behind a cloud. If a lone enemy could be lured to attack the bait, the second plane would swoop down on him unawares.

The Germans first applied the exaggerated massing of planes to their squadrons on the Western Front in the spring of 1916. Richtofen and Boelke, stars of the German aviation corps, appear to have been mainly responsible for the development of this idea. Captain von Richtofen, the "Red Baron," was the World War ace of aces. This great German flyer, with a record of eighty enemy planes downed in action, was finally killed by a comparatively unknown Canadian aviator, Lieutenant Roy Brown. Captain Oswald Boelke accounted for forty planes before he too was shot down over Belgium.

Banished by Mass Flying



In VEE formation, holding perfect alignment, Navy planes, heading for New York, flew over Capitol at Washington.

The daily flight of the Flying Circus, as Richthofen's squadron was known, soon began to take a tremendous toll among the Allied airmen following the German adoption of mass flying. After the United States entered the war, Captain E. V. Rickenbacker, as commanding officer of the Ninety-Fourth Pursuit Squadron, was among the first to recognize the necessity for shifting the style of combat from individuals to that of formations. Rickenbacker, who before the war was an automobile racing driver, held the American record for victories with twenty-five planes.

This new menace, the formation, spelled the doom of the erstwhile "lone eagles." Safety lay only in countering with similar formations. As in a battle in any other element, the force that is broken up can be destroyed individually. Hence, formation work was especially emphasized in the training of new aviators. As the war drew to a close, formations had grown to huge dimensions. A patrol group often would number as many as thirty fighting planes. The control of such a squadron obviously was difficult for a single leader.

Since the war, the problems of pursuit tactics have been thoroughly studied. Both the Army and Navy fighting plane squadrons are composed of eighteen planes each. The smallest tactical unit is the section of three planes each. This is an ideal thrusting or feinting group under the immediate command of a section leader.

Three sections combine to form a division in charge of the leader of the first section. A squadron is thus composed of two divisions. The squadron commander acts as the leading section leader of the first division.

This type of squadron organization is workable, but it has several disadvantages. It is too large to be controlled deftly by the commanding officer. Once the squadron has left the ground, the leader must depend upon his pilots to execute properly the attack.

Suppose while searching for enemy fighters a flight of torpedo planes are sighted. This type of plane is susceptible to certain particular (*Continued from page 134*)

High flyers of the Ninety-Fifth Pursuit Squadron, U. S. Army, maneuvering above the clouds near the California coast. They have flown in formation at 33,000 feet, more than six miles above the earth. Inset shows a pilot with tube from oxygen tank, which is necessary when the airplanes reach thin air above the "death line."

Quick-Frozen Foods Exactly Like Fresh

By JOHN CHAPMAN HILDER

CLARENCE B. BIRDSEYE, whose method of quick-freezing foods is explained in this article, is a New Englander. For some years he was in the service of the United States Biological Survey, Later he lived in Labrador, studying the ways of foxes and of fish. While there he conceived the idea of developing an artificial quick-freezing process. On his return to the United States, he organized a small company and succeeded in placing quick-frozen fish on the market, but due to lack of capital his company failed. Today, financed by one of the world's biggest food concerns he and his process are about to come into their own.

STEAKS, chops, roasts, chickens, and ducks; fish, oysters, and clams; peas, spinach, cherries, raspberries and many other foods can now be bought wrapped in transparent packages, neatly boxed and frozen hard as marble.

These products are said to be in every way equal in taste, texture, and appearance to the fresh-caught, fresh-dressed, fresh-picked kind. Furthermore, being boned and trimmed, washed and sterilized before packing, they come to you ready for cooking, cleaner and more completely edible and wasteless than their fresh counterparts. Scientific quick-freezing at Arctic temperature has sealed in their natural flavors and their natural juices.

Off the coast of Labrador, some years ago, a biologist named Clarence Birdseye was fishing through the ice. The temperature was around forty degrees below zero. Each fish, as he took it from the water and threw it onto a pile of snow, was rapidly frozen stiff.

There was nothing unusual about that. The unusual feature was that later, when these fish were thawed out, many of them came to life. This phenomenon gave Birdseye to think, as they say in France. For he knew that ordinarily, when a fish is frozen, the ice crystals that form in its body tear and bruise the tissues and destroy the cells of which its flesh is made up.

All flesh, of fish or animals, contains a large percentage of water. It is impossible to freeze water without producing ice crystals. Yet here were fish that had been frozen solid but which gave no evidence that destructive crystals had been formed inside them.

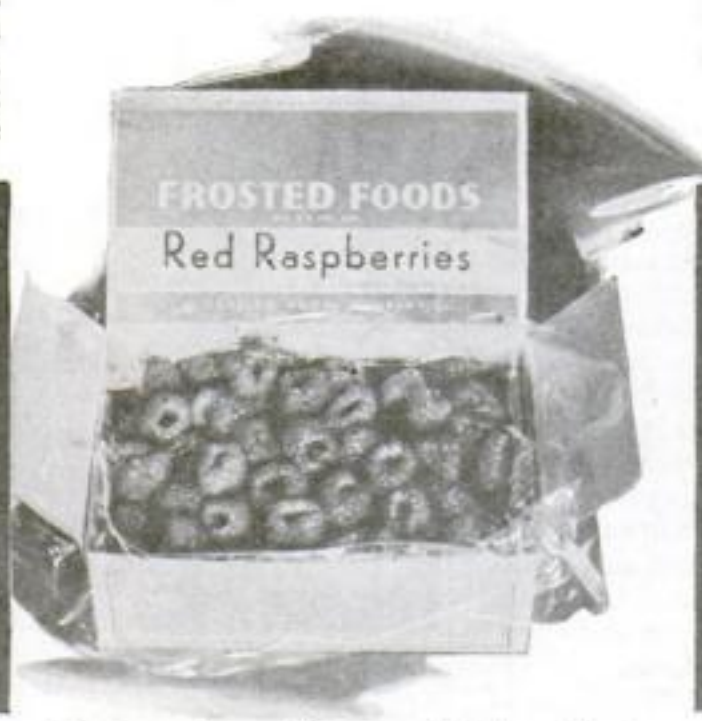
A knowledge of crystal formation gave Birdseye the explanation. Here it is: the size of crystals depends on the time allowed for them to form. Fish frozen by cold storage methods take from ten to forty-eight hours to freeze solid. His fish, exposed to the air at forty below zero, had been frozen through so quickly that the ice crystals formed in their cells had been too tiny to tear the cell walls.

This meant that, upon thawing, the flesh was absolutely the same as before freezing. With ordinary, slow-frozen fish, the flesh is radically different from its original state. The fibers are compressed in bundles; the natural moisture, squeezed out of the cells, cannot return because the cells are broken and consequently it drips out.

BIRDSEYE realized that if he could invent a practical method of artificial quick-freezing, he could make available to folks living hundreds of miles from the seashore frozen fish that would be in every way as desirable as fresh. This he set out to do. After years of

Foods packed and frozen by the Birdseye method were put on sale in Massachusetts and their reception by the public showed that such goods will meet with quick demand.

Oysters, sealed in a package, are turned solid by quick-freeze process and lose none of the juice.



Birdseye plans on freezing all kinds of foods. These raspberries, when thawed, will be like fresh.

Meats are sealed in a carton and then frozen in hard bricks, but they taste like market cuts.

experiment, he succeeded in evolving a process applicable not alone to fish, but to meats, vegetables, fruits, and other products.

Quick-freezing can be done in various ways. Birdseye has no monopoly on the principle. The system of Dr. Harden F. Taylor, which has been in successful operation for a couple of years, the Kolbe processes, and the "Z" process in Europe are among the best known methods. These differ chiefly in the mechanical application of the basic principle. All, in one way or another, bring the product to be frozen into indirect contact with an intensely cold refrigerant.

ONE method is to place the food on a metal pan or tray which is floated in a trough containing the freezing fluid. Another method is to place it on an endless metal belt, the underside of which is sprayed with the refrigerant. With these and similar methods, only one side of the food is given contact with the freezing agent. If the product so treated is thin, such as a fillet of fish, or a lamb chop, the result is satisfactory. Thicker products, such as whole fowl, or whole fish, are placed in hermetically sealed containers which are lowered right into the frigid fluid.

Flesh products, when frozen, pass through what is termed a zone of maximum crystallization. This lies between the temperatures of thirty-one and twenty-five degrees Fahrenheit. It is while foods are between these temperatures that the bulk of their water content forms crystals. The object of quick-freezing is to rush products through this crystal-forming zone as swiftly as possible.

A two-inch package of haddock fillets, frozen by the old method of exposing them to cold air, will take, say, ten hours to freeze solid. During six of those ten hours, the fish will be passing through the zone of maximum crystallization. In other words, it will take six hours for it to reach a temperature of twenty-five degrees, at which point the enlargement of individual crystals practically ceases.

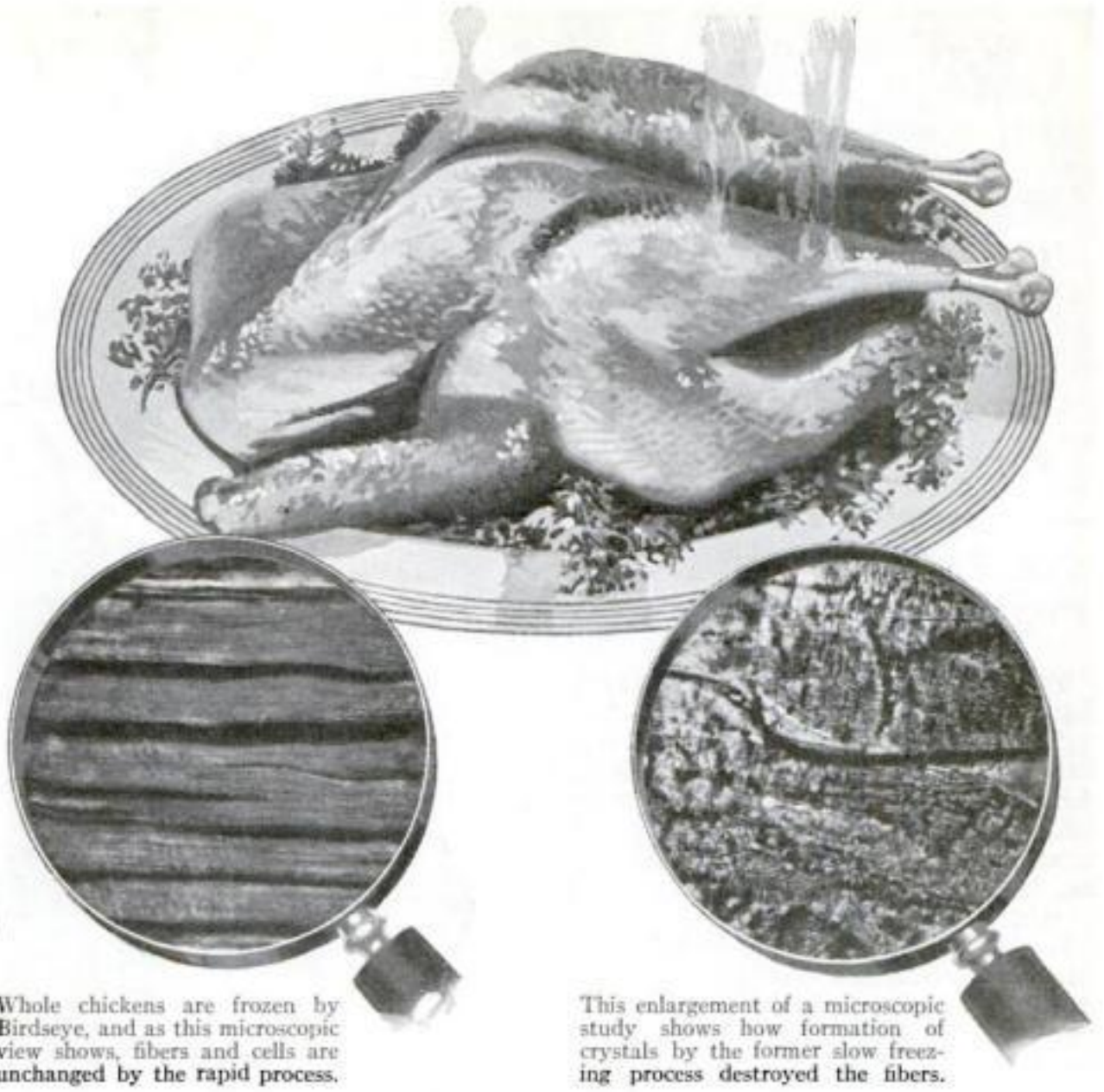
By contrast, an identical two-inch package of fish can be frozen solid by the quick-freezing process in one hour and a half. Instead of six hours, it will take only twenty-five minutes to chill it through to twenty-five degrees. Quick-freezing rushes it through the zone of crystallization fourteen times as fast as the old method.

The time required for complete quick-freezing depends, naturally, on the thickness and physical characteristics of the foodstuff treated. Obviously, it would take longer to quick-freeze a six-pound cut of beef than a half-pound fillet of fish.

ONE of the most important problems to be solved in order to make quick-freezing commercially practicable was to determine exactly how long the various products needed to be exposed to cold and exactly what temperatures were best. A speed and temperature that would satisfactorily quick-freeze one product might only "sharp-freeze" another. (Sharp-freezing is used to denote the old, slow methods.)

Using solidified carbon dioxide, or "dry ice," which has a temperature of 109.6 degrees below zero, in a freezer designed for experimental work, five-eighth-inch fish fillets have been quick-frozen in from three to five minutes, one-inch pork chops in ten to twelve minutes, and 150 pounds of one-inch cuts in an hour.

Vegetables and fruits differ more widely in their composition and structure than do meats and fish. Experiments are still being carried on with individual varieties in order to standardize a quick-freezing technique adapted to each.



Whole chickens are frozen by Birdseye, and as this microscopic view shows, fibers and cells are unchanged by the rapid process.

This enlargement of a microscopic study shows how formation of crystals by the former slow freezing process destroyed the fibers.

This is the kind of refrigerator display case that will be found in every store when the Birdseye quick-frozen foods are on the market in quantities. Storing the food is still a big problem.

THE Birdseye process differs from the rest in one important respect. Whereas with the others the foods are frozen and then wrapped, with his method they are wrapped and packaged before being frozen. In his system, the food, sealed in transparent cellulose material and packaged in rectangular pasteboard cartons, is passed through a freezing tunnel between two moving monel metal belts, one above and one below. Both these belts are sprayed on their reverse sides with calcium chloride brine at about fifty degrees below zero. The even pressure exerted by the belts prevents distortion of the packages by confining the expansion of the frozen products to the limits of the package walls. They come out of the machine like so many bricks.

Several advantages are claimed for this scheme of wrapping before freezing. In any freezing or (Continued on page 126)

NEW IDEAS AND INVENTIONS

On this and succeeding pages are described the latest achievements of inventors and novel applications of scientific progress

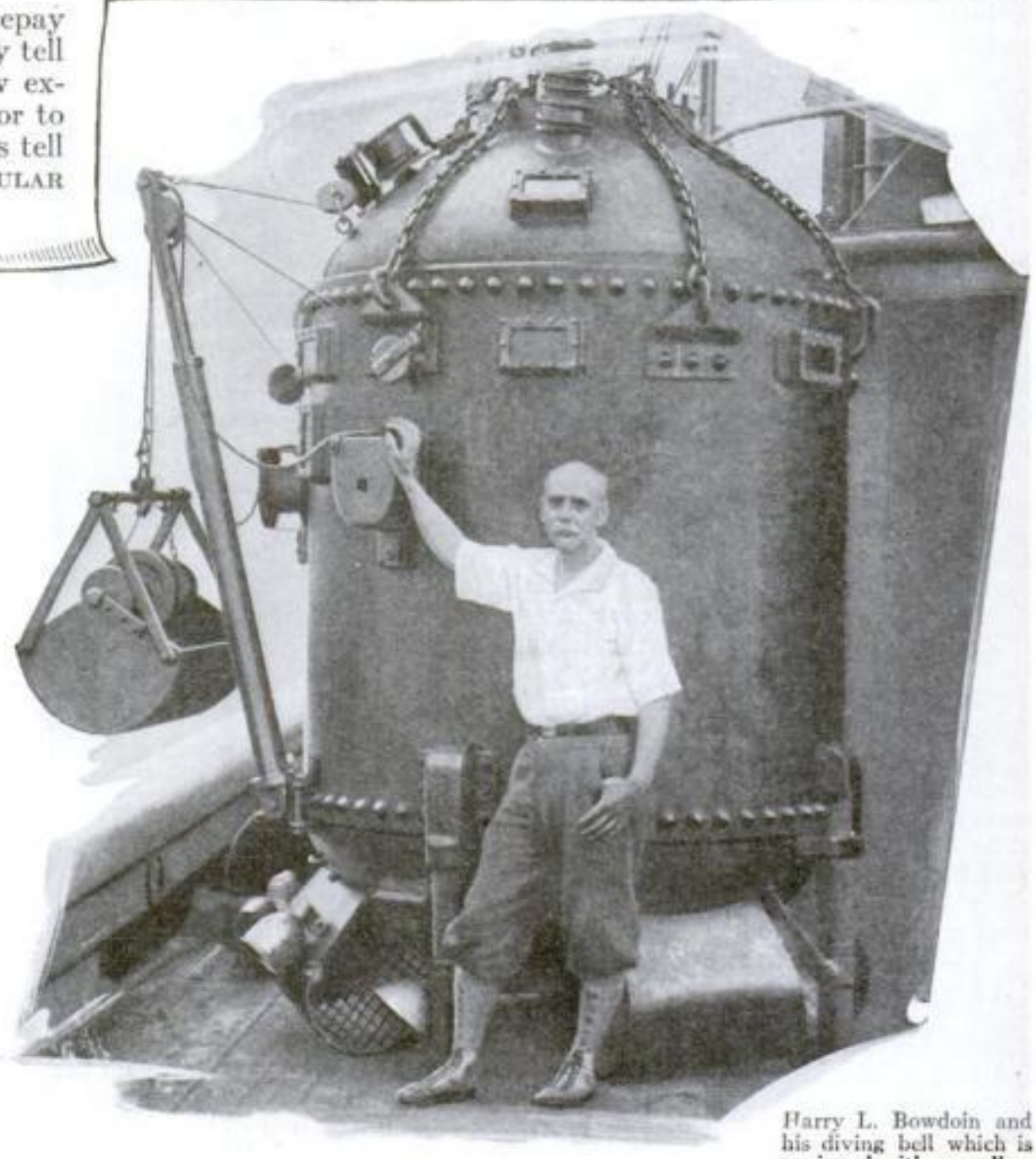
One single item in these pages may repay you well for months of reading. It may tell you of a device, that you never knew existed, to help you in your daily work or to add to your comfort. Dozens of letters tell how others profit from this part of POPULAR SCIENCE MONTHLY every month.

POWERED DIVING BELL CRAWLS ON SEA'S FLOOR

TO AID a hunt for sunken treasure, Harry L. Bowdoin, of Whitestone Landing, N. Y., invented a diving bell that can wander about the bottom of the sea at the will of the operator within it. Propellers at its bottom, driven electrically and housed behind guards of wire netting, enable it to crawl on the sea's floor like a crab.

Its first try-out was a 135-foot descent into Long Island Sound off the Connecticut coast, with Bowdoin and a companion inside. Later Bowdoin plans to attempt the salvage, with its aid, of a cargo of copper known to have sunk in that vicinity.

When a descent is made, air is supplied to the occupants of the bell through armored tubes from the tender ship at the surface. Three floodlights illuminate the water around the bell, and the men inside can peer out through the heavy glass windows in its wall. The bell swings along the bottom, as if on a leash, until it locates a sunken vessel's cargo to be salvaged. A scuttle-like arm at the side helps to scoop up any treasure that might be spilled on the sea floor.

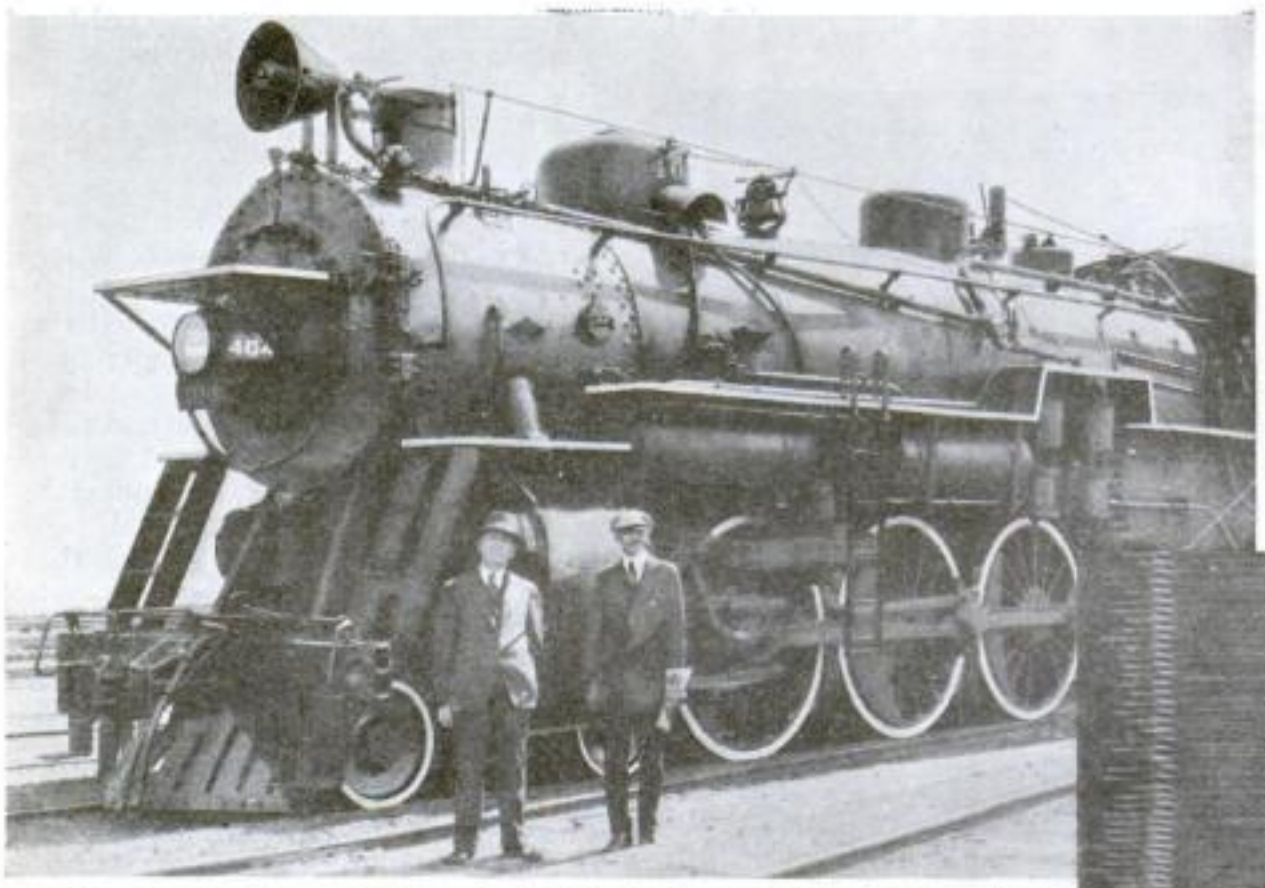


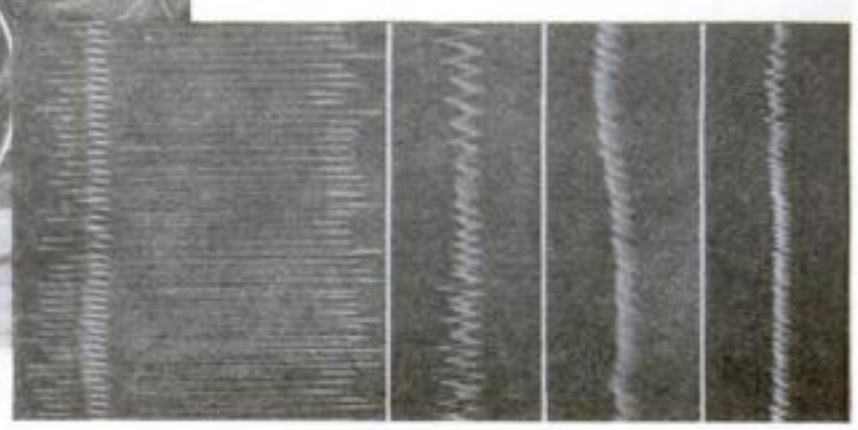
Harry L. Bowdoin and his diving bell which is equipped with propellers that drive it on sea's floor.

ONE-WAY WHISTLE TRIED ON ENGINE

DWELLERS near a railroad will be undisturbed by the blasts of a one-way locomotive whistle, recently tested by the Missouri, Kansas, and Texas Railway. It can be heard only from straight ahead. A funnel-shaped reflector of aluminum alloy directs its sound at a highway crossing in a fan-shaped beam like that of an automobile headlight.

Test photographs, below, were made with sound-recording apparatus from all sides while the whistle blew. Wide wavy lines at the left show the loudness of the blast to a listener in front. The narrow lines show little was heard on the other sides.





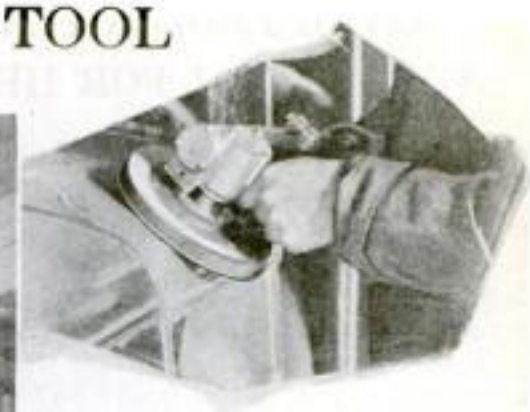
Noise from this beam whistle travels straight ahead. Sound photos at right show heavy lines in front of engine, but as little was heard at sides, the lines are light.

NEW RIGHT ANGLE DRIVE IS A VERSATILE TOOL

A RIGHT angle electric drive that can be used as drill, saw, or polisher is now on the market. This new combination tool should prove a big aid for mechanics.

The tool is driven by a self-contained motor. Various attachments are available for use with it. Since the power-driven drill can be inserted at a right angle, it is especially useful for speedy work in corners and other "hard-to-get-at" places, as shown at the right. A small rotary saw and a polishing outfit are also designed for use with the drive.

Above: The right angle drive can be used to bore a wooden beam that in most cases would be inaccessible.



The instrument has many uses and here it is seen with the attachment that makes it an auto polisher.

Nothing seems to stop this motor driven device; above, it is shown sawing through a floor.

BLOWTORCH LIGHT PIERCES FOG

NEWSPRINT can be read at night more than a mile away by a new fog-piercing light, recently demonstrated in London, which combines the principles of the blowtorch and the gas mantle.

Bottled oxygen and liquid fuel produce a blowtorch flame in the new light. The flame is drawn against a disk of thorium oxide, a material commonly used in the manufacture of gas mantles. The result is a brilliant white light which pierces the densest London fog. In a test of its brightness, occupants of an automobile a mile away read a newspaper by the light.

CHICAGO MOLDS MASK OF CROOKS

MOULAGE is the latest weapon to be placed in the hands of Chicago police to aid them in their war upon crime. This material is used in making casts of criminals' hands or faces, and the tools of their trade.

Similar materials have been used with startling success in Europe (P. S. M., May '30, p. 26) to reconstruct all the physical evidence and objects of crime, the criminal, and his victim. Chicago sent to Europe for Dr. Ferdinand Watzek, an outstanding master of this "death mask" method of detection. He is now assistant director at the scientific crime detection laboratory at Northwestern University.

The chief advantage of moulage lies in the ease with which it can be used in making casts of living persons. Of great plasticity, it produces an exact image of the subject. It is capable of showing each individual hair. Fingerprints can be reproduced so perfectly that they are as reliable as those from a living person.

In work with a live object, moulage has the advantage of hardening quickly. A head may be reproduced in half an hour. This new modeling material is expected to be of value to American police experts.

Inspector Ferdinand Watzek, of Chicago police, center, explains to Coroner H. M. Bundesen, left, and Dr. C. W. Muehlberger, of crime detection laboratory, how to make moulage of cartridge in magazine.

BIGGEST CANAL LOCK OPENED IN HOLLAND

THE world's largest canal lock, a quarter of a mile long and capable of raising the biggest ships, was opened recently at Ymuiden, Holland. It marks the ocean end of the North Sea canal, which enables ocean liners to reach Amsterdam.

Despite its great size, the lock can be filled with water in twelve minutes. Its three gates, which weigh nearly 1,500 tons apiece, roll into place on rails. Measuring 1,312 feet long by 164 feet wide, it dwarfs all other structures of the kind. Its closest competitor, now under construction at Bremerhaven, Germany, will be 1,155 feet long.

LIGHTED STRIP IN ROAD STOPS ENGLISH CARS

DRIVERS who may ignore a red light overhead are stopped effectively, it is reported, by a new traffic device recently put into use in England. The invention consists of an illuminated strip crossing the road, made up of a number of lights beneath glass lenses buried flush with the pavement. Stop signals are given by illuminating the dotted line of lamps, and the driver must not cross the line. It is harder psychologically, experts point out, to pass such a barrier than a stop light above the eye level.

BENZINE PRODUCT MAY RIVAL STEAM FOR HEAT

THE strange behavior of a yellowish-white substance called "diphenyl" suggests that better things than steam may be found to heat homes, the American Institute of Chemical Engineers was told recently.

Many house-heating systems use steam to carry heat from the boiler to the radiators, simply because it is easy to produce from water, holds considerable heat, and can be driven through a pipe. Obviously any other substance that would meet these requirements would do as well.

One of them, at least—the ability to hold heat—is far surpassed by "diphenyl." This is a solid at room temperature but melts at 157° F. and vaporizes at 492° F. It is made from benzine by a high-temperature process. Its especially noteworthy feature is that it can be raised to a greater temperature than steam without developing dangerous pressure.

That some related substance with these properties may be found is possible. Diphenyl itself is a recent product. Two years ago a gasoline refiner wanted some for a gasoline making process, but so little was available that it would have cost him forty dollars a pound. Now Theodore Swann, a young chemical maker of Birmingham, Ala., has developed a process by which it can be produced for only thirty cents a pound wholesale, resulting in its present commercial use.

PICTURE ON CHECK MAY PREVENT FORGERY

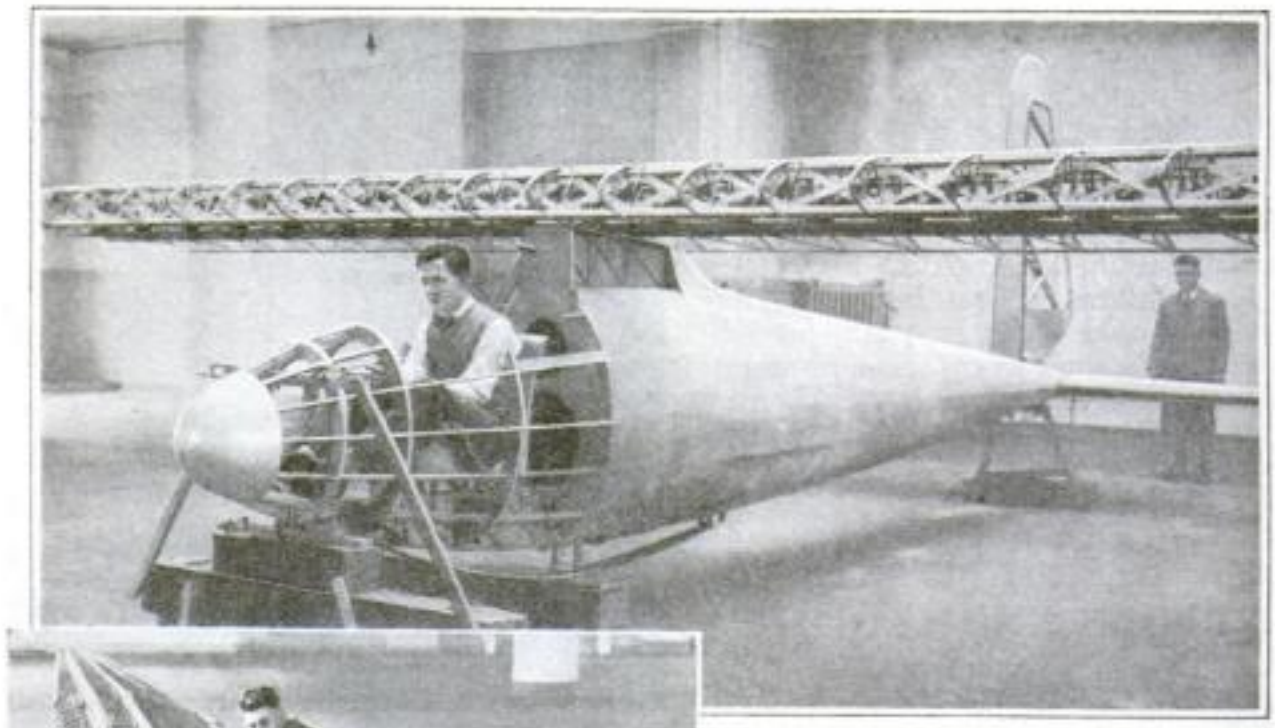
TO PREVENT fraud in forging and cashing checks, an ingenious method of identification has been conceived by a depositor of an English bank.

When the signature is applied to the check, the signer pastes an adhesive stamp bearing his portrait alongside of his name. The stamp would be furnished by the bank with each check book.

Picture of drawer of check is pasted beside the signature as a protection against possible forgery.

Under special arrangements, the bank would accept only the checks that bore a portrait of the maker in addition to his name. The device is being considered for adoption by one of Great Britain's leading banks.

BIGGEST GLIDER TO SEEK NEW RECORD



Above, Hermann Benz, designer of world's biggest glider, is seen in cockpit of his plane. At left, the seventy-foot wings are shown all ready to be covered with fabric.

SEVENTY feet from wing tip to wing tip, a craft now under construction at Meiningen, Germany, is to be the world's largest glider. Its builder, Hermann Benz, plans to fly it from the top of the Wasserkuppe, in the Rhoen Mountains of Germany, where ideal gliding conditions prevail, in an effort to set a new sailplane record.

Benz is assembling the craft from 15,000 separate parts. It will be of the "sailplane" type—that is, an extremely light and fragile glider capable of record flights. Gliders for amateur pilots, more ruggedly built, are too heavy to rise in up-currents of air.

THIS MOTOR FUEL DEFIES WEATHER

A FOUR years' search for a better motor gasoline has disclosed a remarkable fuel that gives a car more power, both in the heat of summer and in winter's cold. Prof. George Granger Brown, University of Michigan chemical engineer, who discovered the formula for the blend, has no intention of profiting from it. Instead, as a gift to the world, he has made the formula public.

To ordinary gasoline he adds two ingredients — "natural gasoline" and naphtha. The natural gasoline vaporizes so readily that quick cold-weather starting is assured. Naphtha begins to act when the engine of a car gets hot, and actually prevents excessive vaporization of fuel.

"OWL" SWITCH STOPS RADIO

YOU may forget to turn off the radio when you go out of the room, but a new accessory will shut it off for you.

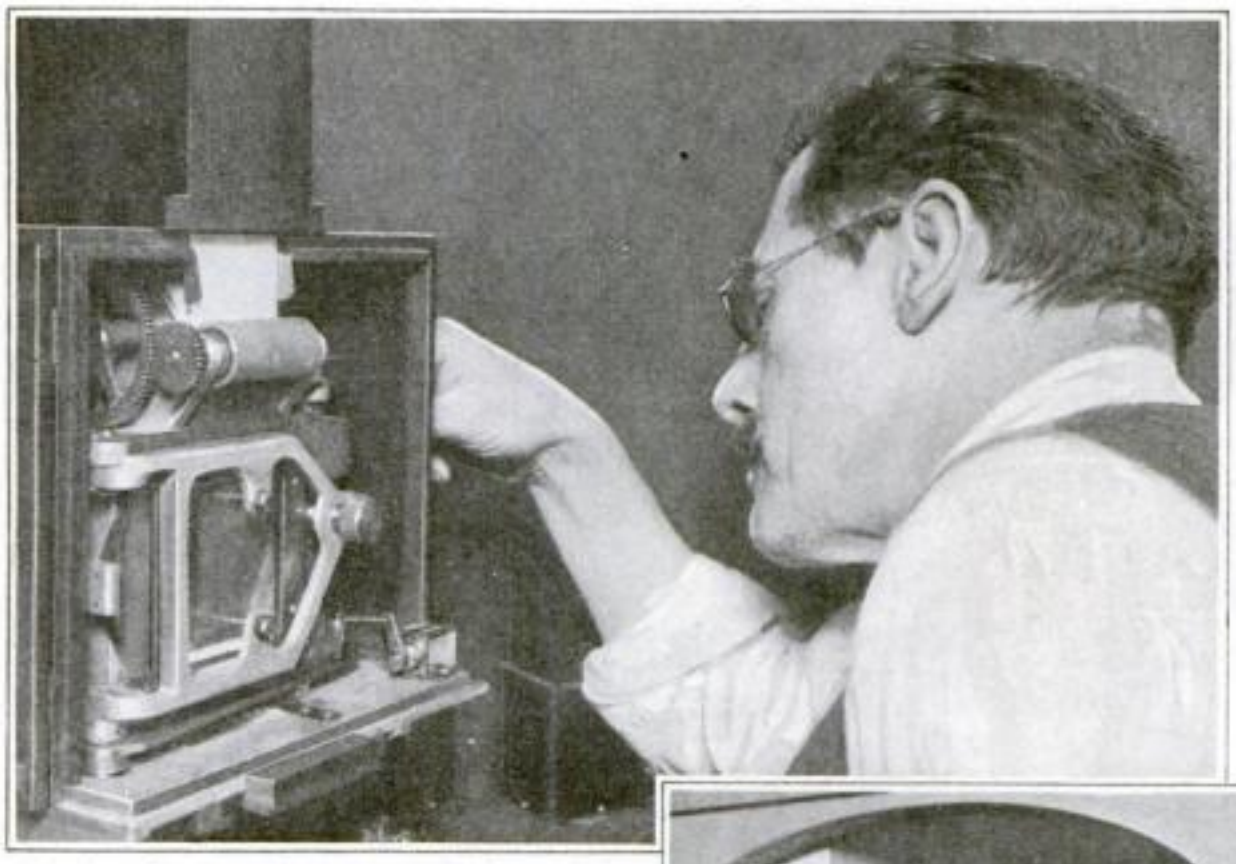
The new device is a time switch, inclosed in a case designed to resemble an owl. When the radio is turned on, the switch is set for a given time. At the end of that time it cuts off the current.

Within the body of the "owl" the setting of the switch raises a plunger against the pressure of a spring. While in operation the plunger is forced slowly downward against a buffer of oil in a chamber. At the bottom it trips the shut-off switch.

PLAN DOUBLE-DECK LIFT

DOUBLE-DECK elevators appear for the first time in plans filed recently for a sixty-three-story skyscraper to be built in New York City. The elevators will load and unload at two floors simultaneously. Passengers for odd-numbered floors will ride in the lower compartment, and those for even-numbered floors will use the upper one.

MOVIE PHOTOS BY AUTOMATIC CAMERA



Interior of camera that automatically makes six-minute picture in three different poses. A 1,000-watt bulb is used in the operation.

In the booth in front of the three-pose camera. Note the props supplied to give photo realism.

MOST everybody is familiar with the small novelty pictures that seem to dissolve and change into a different view of the subject when the picture is bent or twisted.

An idea somewhat similar is used by S. J. Pask, camera designer of New York, who has invented a new camera that takes these composite view pictures automatically and in quick succession. They are to be installed at beach resorts.

The subject need only stand in front of the lens, move the head into three positions, or assume three different facial expressions. Three exposures are made on the same film through a finely slitted screen that moves sidewise the width of the slit between each exposure.

When the film has been automatically developed and finished, it is fitted by the operator into a cardboard frame under a semitransparent screen which has clear streaks like those in the taking screen. By bending the frame or pressing sidewise with the thumb the screen is shifted so that each view can be seen in turn, thus giving the suggestion of an animated picture. Pask has succeeded in cutting the time necessary to make and develop the picture to six minutes.

TWO-ENDED POINT MADE FOR FOUNTAIN PENS

FOUNTAIN pens with reversible tips are a recent innovation. If the pen point is damaged, it takes only a moment to pull it out and replace it in reversed position.

The two-ended pen points, according to the maker, should prolong the life of a fountain pen almost indefinitely, since a damaged point is credited with being the most frequent cause of trouble. Another advantage lies in the fact that pen points may be supplied with two different types of tips, if the owner desires; as, for instance, a fine point at one end and a thick stub point at the other.

CODE WHISTLE REVEALS SHIP'S COURSE IN FOG

A STEAMER'S whistle sounds, near at hand, from the fog that blankets mid-ocean. Which way is she heading? Can the skipper who hears the whistle avert a collision?

These questions are answered by the recent invention of an electric timer that sends coded whistle blasts to reveal a steamer's course. It resembles a clock, but it has a compass face instead of an hour dial. The captain of a fog-bound vessel will set the dial to the course he is steering and close an electric switch. Automatically the device will blow the whistle at intervals of a certain number of seconds. The time between blasts indicates the course. Thus an interval of one minute and fifteen seconds would indicate the ship was running due east.

On board a near-by vessel, the time between blasts is observed and the course of the neighbor ship thus ascertained.

The device was recently demonstrated aboard the *Leviathan*. According to its inventors, Capt. Robert Kamdron, of Seattle, and Capt. George Stavrakov, of Victoria, Canada, the instrument, which would cost about $300, meets existing international steamship regulations.

JELLY GOBLETS ARE NOW FIT FOR TABLE USE

JELLIES sold in goblets are the recent result of the United States Department of Commerce's campaign against waste. The new glasses, in which a Chicago manufacturer now markets fruit jellies, are colored an attractive jade green and can be used for table service after they are emptied.

Formerly, jellies, jams, and preserves have been sold in glass containers of assorted sizes and shapes, usually thrown away after the jelly was removed, although the cost of making them was necessarily included in the price of the jelly. The new plan saves this loss.

CHAIRS, MADE TO SLIDE TOGETHER, STORE EASILY

A NEW chair for use in the home, restaurants, and banquet halls slides into the back of another exactly like it. Any number of chairs may thus be pushed together for storage. Each one requires only two inches of additional space.

The chairs, identical in shape and size, were designed by Louis Dellert, Brooklyn, N. Y. The secret of his success lies in the fact that the seat of each chair slopes a little downward, and is slightly narrower at the front. Thus the seat of one chair fits snugly into sheet metal sockets beneath the seat of another.

Outwardly the chairs cannot be distinguished from more conventional furniture. They are useful, the inventor says, for housewives who need extra chairs that take up little room when stored. Restaurants also would like this feature.

A sloping seat, narrow in front, with open metal frames, makes it easy to nest these new chairs.

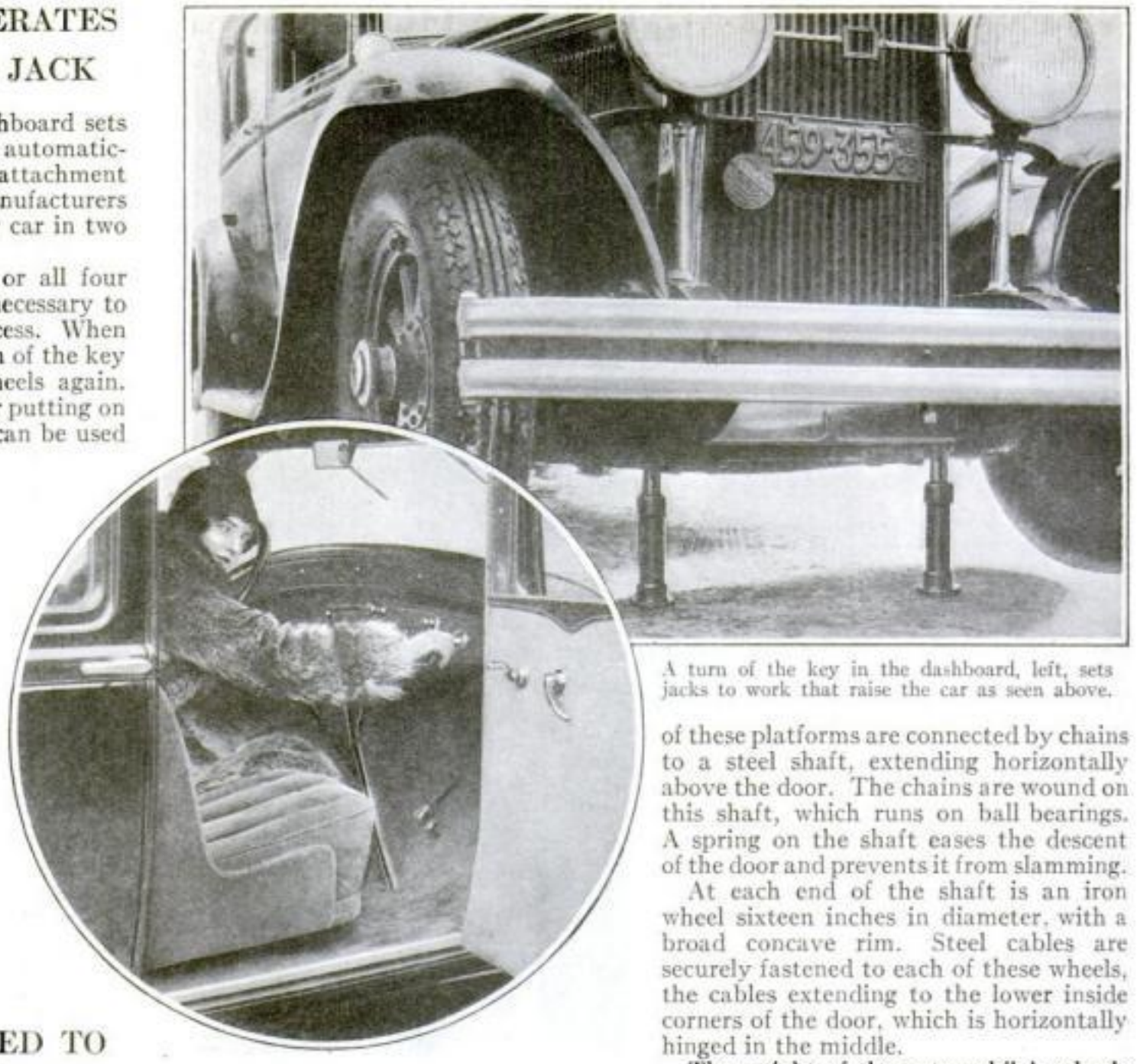
TURN OF KEY OPERATES AUTOMATIC CAR JACK

TURNING a key on the dashboard sets in operation a new device for automatically jacking up the car. The attachment that does this trick, the manufacturers state, can be installed on any car in two hours.

One wheel can be raised, or all four wheels at one time. It is unnecessary to leave the car during this process. When repairs are made, another turn of the key lowers the car on to the wheels again. The jack is also convenient for putting on or removing skid chains and can be used as protection against theft. Raising the rear wheels while parking prevents moving the car.

The jacks work by hydraulic pressure in their cylinders. There are four of them, one for each wheel. They can be worked separately by the key control, or simultaneously, and they will hold the car off the wheels for as long as is desired. In normal position, they are drawn up, allowing usual clearance.

These jacks should appeal to women, as they keep hands and clothes clean, away from car's chassis.



A turn of the key in the dashboard, left, sets jacks to work that raise the car as seen above.

AUTO'S WEIGHT USED TO OPEN GARAGE DOOR

A GARAGE door that opens and closes of its own accord as an automobile goes in or out has now been placed on the market, after extensive preliminary trials.

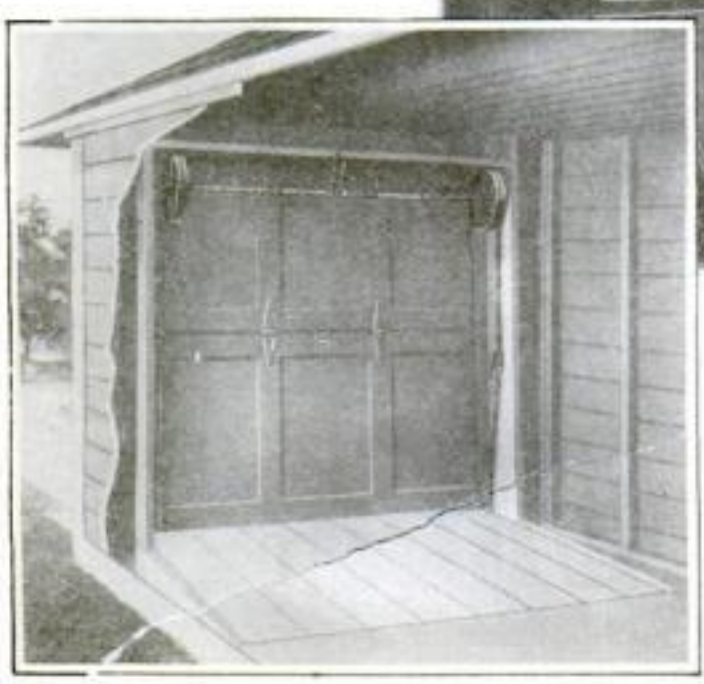
When the motorist approaches his garage, the door opens. Once in, the door closes behind him. If the car is in the garage, merely backing toward the door opens it and it again closes when the automobile is out. The weight of the car operates the door.

The mechanism by which this is done consists of a slightly inclined approach, the width of the garage door. As the wheels of the car reach this platform it is depressed by the weight and the door opens. A similar platform is on the inside of the garage. The sides of these platforms are connected by chains to a steel shaft, extending horizontally above the door. The chains are wound on this shaft, which runs on ball bearings. A spring on the shaft eases the descent of the door and prevents it from slamming.

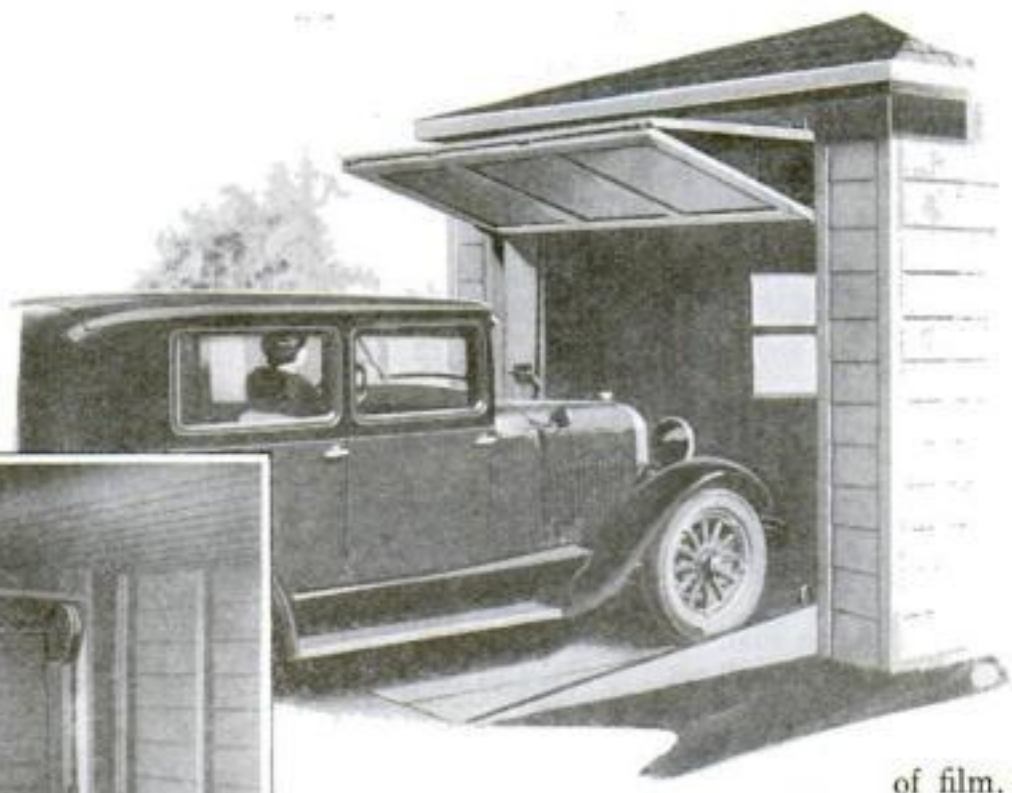
At each end of the shaft is an iron wheel sixteen inches in diameter, with a broad concave rim. Steel cables are securely fastened to each of these wheels, the cables extending to the lower inside corners of the door, which is horizontally hinged in the middle.

The weight of the automobile's wheels depresses the platform, causing the chains from the shaft to be drawn taut. This operates locks fastened to the door frame at either side, which release the door. The weight unwinds the chains from the shaft, thereby turning the wheels and winding up the steel cables. The door, folding at the hinges, is thus drawn up out of the way, allowing the automobile to enter the garage.

The combined length of the two platforms is such that, even if the automobile being driven into the garage has an extra long wheelbase, either the front or rear wheels will always be on one of the platforms, holding the door open.



At left the inside of the garage is seen with the door closed. Note inclined platform which, depressed by car's weight, opens the garage door when backing out or entering.



The car's wheels on this inclined platform release weights that swing the hinged garage door open. A similar platform inside automatically opens the door when backing out.

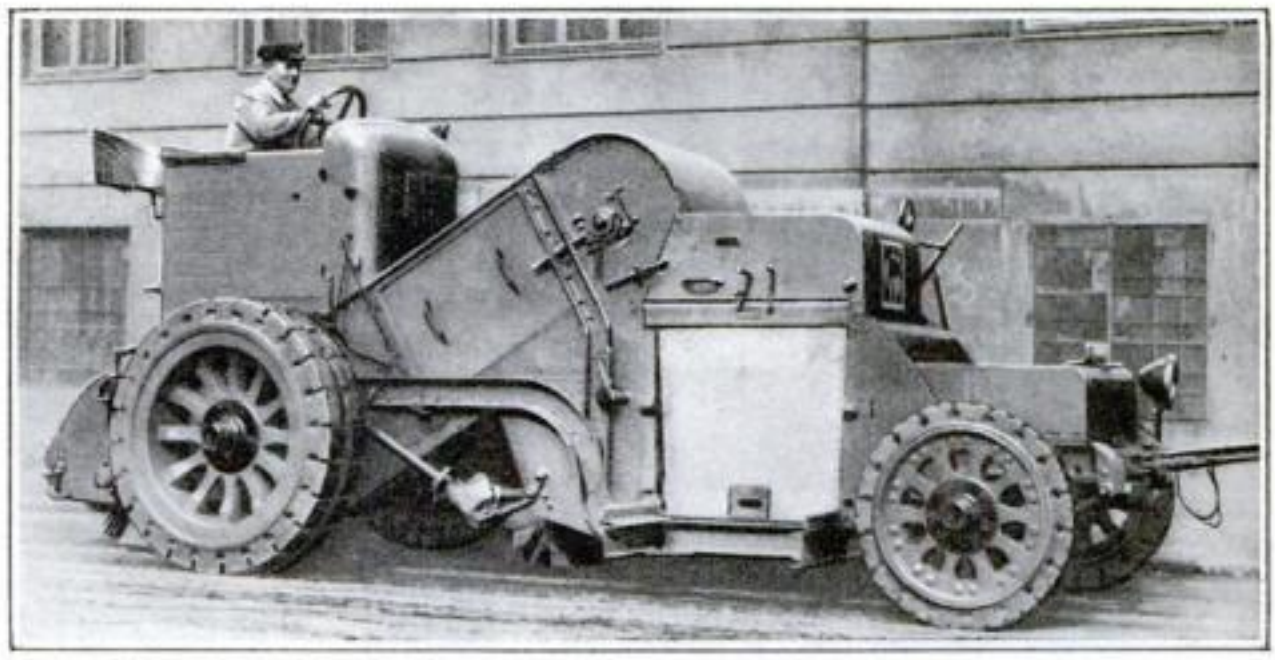
CAN DEVELOP THIS FILM IN SECTIONS

BECAUSE amateur photographers often want to see the results of their first pictures before exposing the whole roll of film, a German inventor, A. Krumm, has patented a roll that makes this possible. Instead of the usual continuous strip of sensitized film, Krumm has made his roll a string of separate films fastened together with pasters. After taking a picture, the section of exposed film may be torn from its paster and developed at once, without damage to the remainder of the roll.

VACUUM STREET CLEANER SCATTERS NO DUST

THIS queer looking truck is a new street cleaning machine put into use the other day in Vienna, Austria. It is equipped with powerful brooms which sweep the rubbish and dirt into piles. These piles are then pneumatically drawn up through a yawning mouth that looks like a mammoth vacuum cleaner. Whirling fans, operated by the motor, do this part of the job.

Its advantages are said to lie in the fact that it cleans the street in one operation, sweeping and removing the rubbish simultaneously. It also has the healthful attribute of leaving the air clear behind it, as none of the dust escapes to cloud and poison the atmosphere.



This truck, working like a huge vacuum cleaner, sweeps the streets of Vienna, Austria, and gathers the rubbish into its tank without filling the air with disease-laden dust.

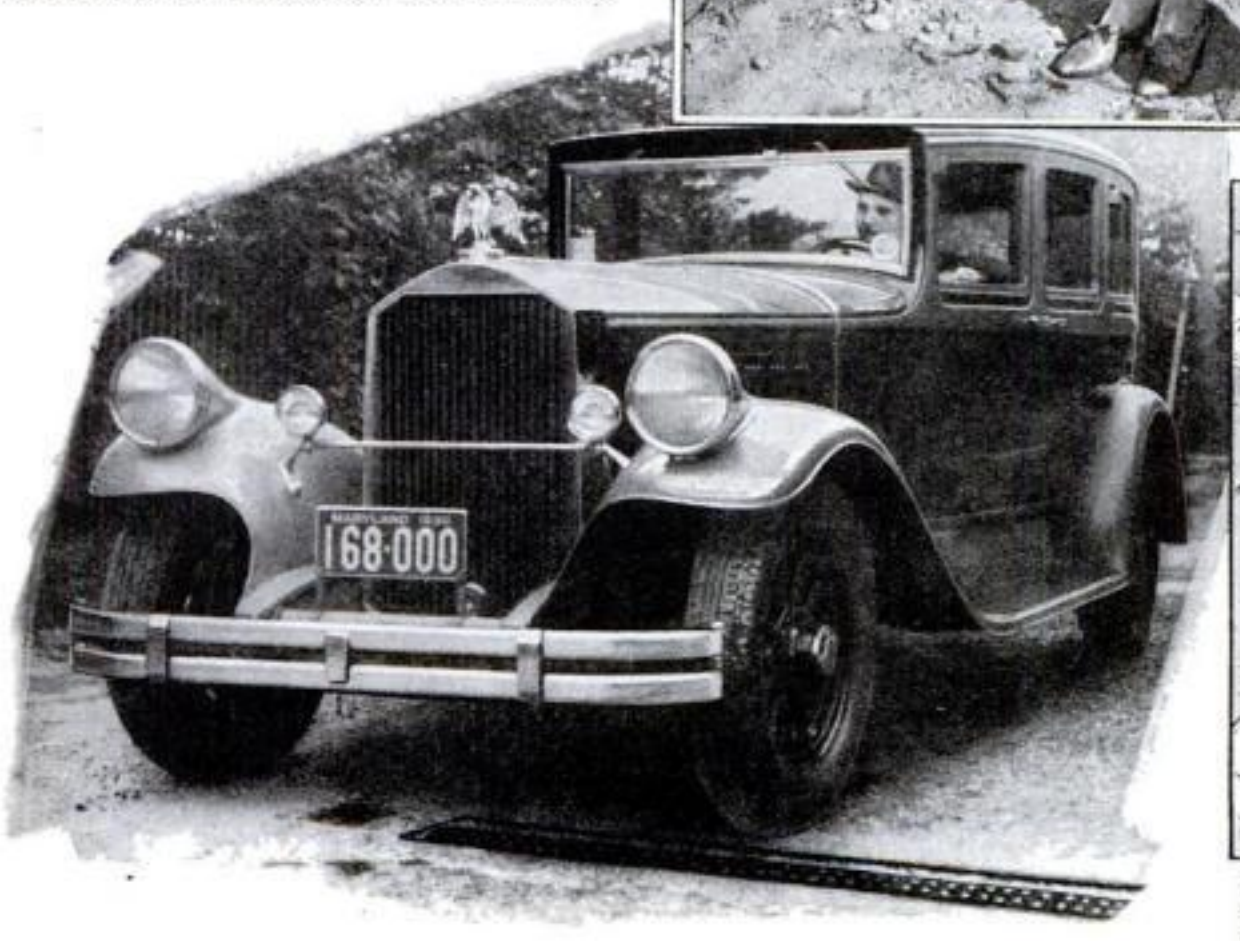
NOISE OF TRAFFIC WORKS STOP-LIGHTS

METAL ears to control traffic lights are being installed by the Baltimore police department. These "ears" change and regulate traffic signals automatically according to the noise made by the traffic at the intersections.

The new invention, developed by Charles Adler, Jr., Baltimore engineer, is installed at the intersection of highways. A red light is flashed for the crossroad until traffic appears on it. Then the light changes and the car on the crossroad is given the signal to proceed while highway traffic is stopped. In the case of a long line of cars on the crossroad, the signal changes back after a predetermined time. Thus it automatically balances movement of traffic.

Pedestrians wishing to cross the highway can change the lights by pressing a button located on a pole at the intersection. This also is regulated by determined intervals to avoid halting traffic on the highway for too long a time.

The lights are controlled by the detection of sound of crossroad traffic moving towards the intersection. Buried in the right-hand half of the crossroad, about sixty feet from the intersection, is an empty steel box. It contains no mechanism and has no moving parts. Its hollow interior conveys the sound produced by automobile tires as they pass over it, through tubing, to a microphone. Here it is converted into electrical impulses which control the signal mechanism.



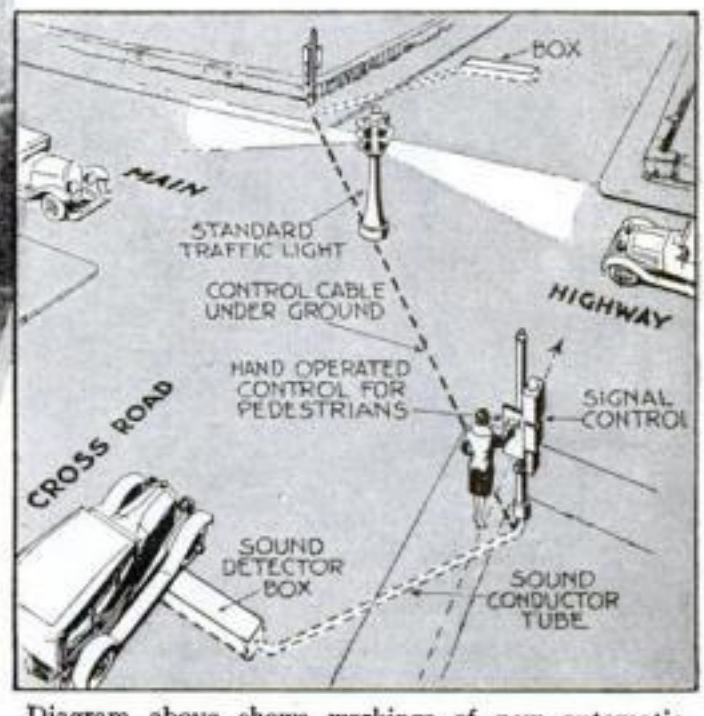


Diagram above shows workings of new automatic traffic control system. At left, car about to pass over sound detector box in roadway. Top picture shows button mechanism by which pedestrians control lights.

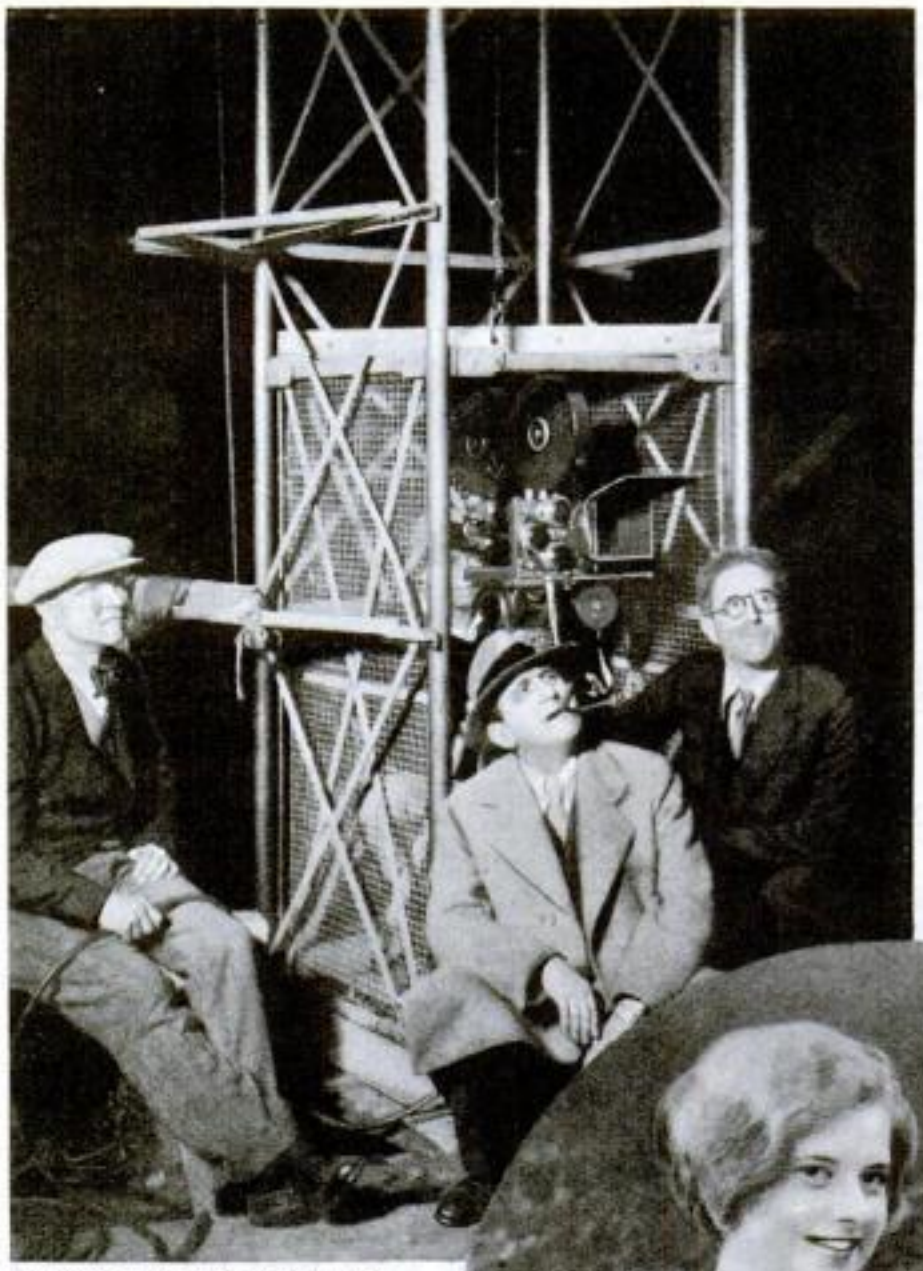
REMOTE STARS TRAVEL 7,200 MILES A SECOND

SPEEDING away from the earth at a rate of 7,200 miles a second, a faint group of nebulae, galaxies of stars beyond our system, was awarded the record for astronomical speed by the astronomers at Mount Wilson Observatory, in California.

The observatory's 100-inch telescope, largest in the world, was the instrument that timed this immense rate of speed, at which the earth could be circled in less than three and a half seconds. Time exposures of fifty hours each on nine separate nights were made in photographing the nebulae to reveal the rate at which they traveled through space.

Calculations show that these nebulae are seventy-five million light years away. The remotest stars in our own system are only 100,000 light years distant, or about six trillion miles.

Remarkable New Ideas from Many Inventors



PICTURE FROM ANY LEVEL. An elevator to raise and lower a movie camera is now in use. With it, many trick shots and scenes from different elevations can be taken. It is raised and snapped electrically.

HELMETS FOR AUTO RACERS. This strange headgear is designed to protect drivers of racing cars. An isinglass screen, attached to visor, protects eyes from the biting wind.

BIGGEST SPEEDOMETER. When a Canadian motor bus hits forty miles an hour, a red section so big passengers can read it flashes into view on this speedometer.

AMATEUR TREASURE FINDER. You can buy parts to build this homemade "radio prospector," which will find a silver dollar buried several inches underground. It makes a buzzing noise when metal is near.

NOVEL HOOK FIGHTS FIRES. This odd device, which resembles the business end of a vacuum cleaner, was demonstrated recently in Germany as a fire-fighting tool. When it is hooked over the rim of a tank of blazing oil or benzine, it discharges a torrent of foaming chemicals into the interior. The floating blanket of froth smothers the flame.

AUTOMAT FOR GASOLINE. Emergency automatic gasoline service stations are being installed in Los Angeles, Calif. A drumlike container with eight sections, each holding a gallon can of gas, is mounted on a post. Motorists drop fifty cents into the slot, press down the plunger, and help themselves. Refund is given for returned can.

NEW MOVIE MIKE. This looks like a searchlight, but it's really a huge bowl that picks up sound and directs it into the microphone that can be seen in the center. The voices of actors thirty-five feet away can be recorded with it.

A TALKING CAMERA. Dropping a coin in the slot of this photographic novelty produces spoken directions about posing and a movie of yourself.

PHONE BOOK INDEX. Finding a name in a telephone book is made easy by the use of these index tabs which are quickly attached. The special gum used makes it possible to read numbers through sticker.

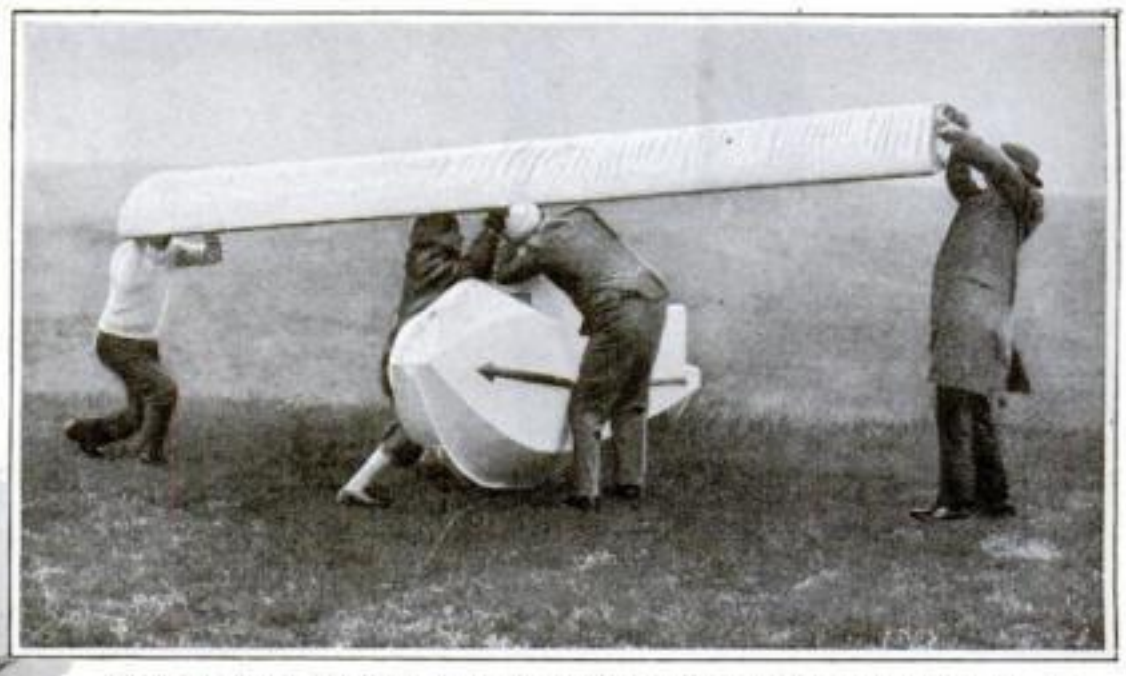
HANDY BRIDGE TABLE. This table contains a built-in scoring sheet, the paper of which is continuous so that the used portion can be torn off. A drawer, closing with a snap latch, holds the cards and pencils. Special brackets clamp ash trays at corners, leaving clear playing space.

COPS SEE BEHIND THEM. Boston traffic police are testing eyeglasses with side mirror which give them two-way vision exactly as rear-view mirrors on automobiles serve motorists.

Gliding Made My Flying Better

This expert pilot, with years of flying experience, finds soaring a postgraduate course and lets you in on the secrets he learned.

"When you hop off," Bowlus, left, told Jordanoff, in cockpit, "swing to the left; get all the lift you can from the currents."



On the ridge at Montauk Point, L. I., the Bowlus sailplane was assembled. It was from this spot that Jordanoff took off on his first cross-country flight.

By ASSEN JORDANOFF

HAWLEY BOWLUS held a silk handkerchief high in the air. It streamed straight into the east. The wind was blowing nearly thirty miles an hour.

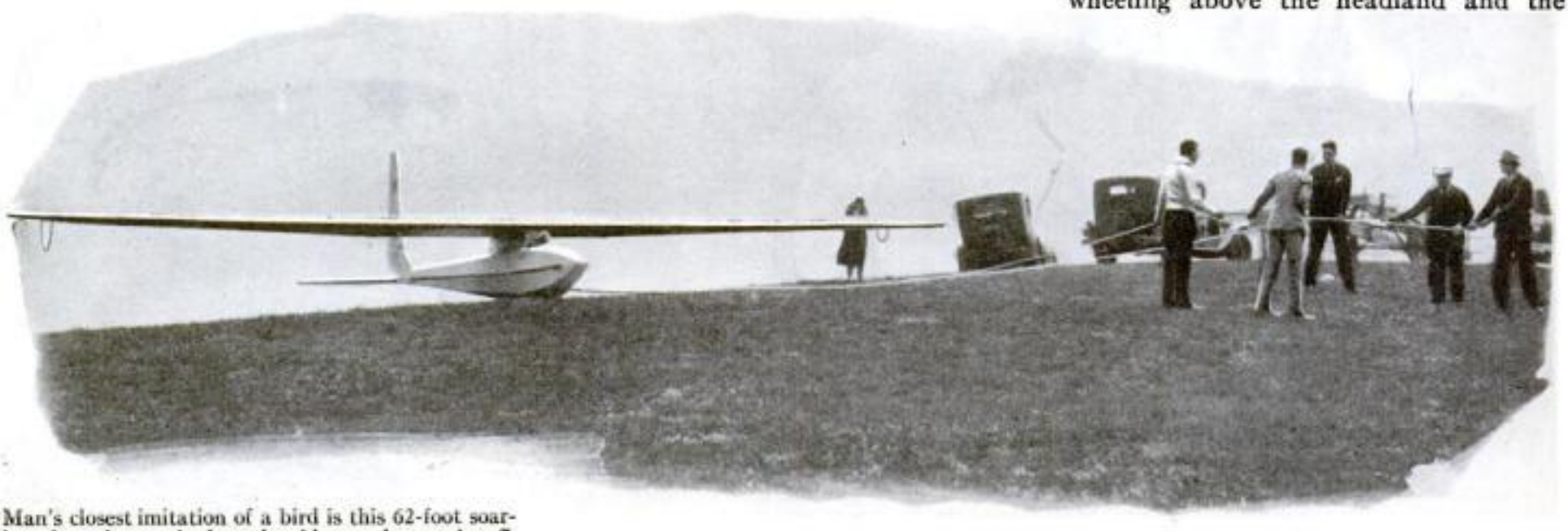
We were standing on a 165-foot ridge near Montauk Point, Long Island. I had just made my first soaring flight, sailing for nearly a mile above the boulder-strewn valley below in the sixty-foot sailplane which POPULAR SCIENCE MONTHLY purchased for me to fly. Now I was to attempt one of the hardest feats in soaring. I was to try to return and land at my starting point. Could I make it?

"When you take off," Bowlus, America's soaring champion, told me, "swing to the left. Hug the ridge. Get all the lift you can from the up-currents and head for that V-formation."

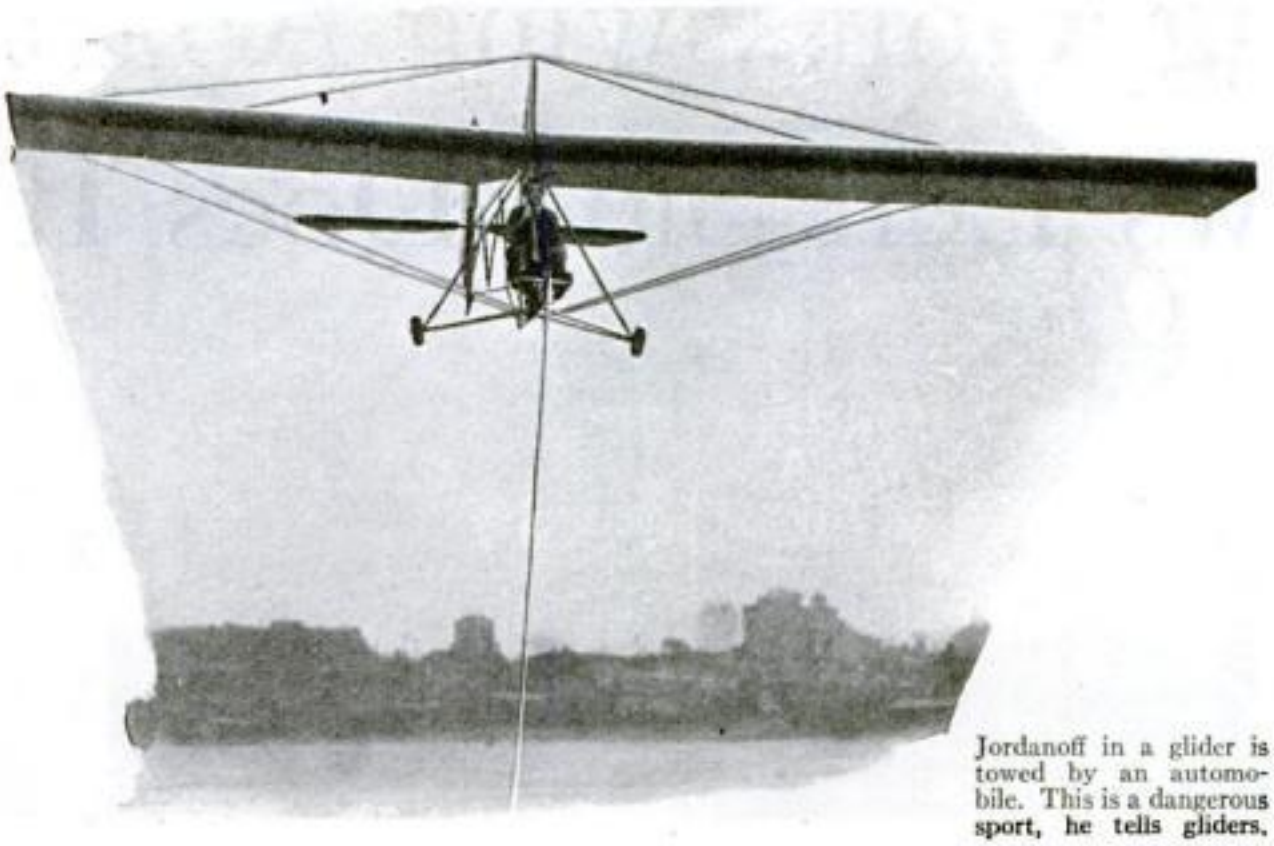
He pointed to the south. A quarter of a mile away, another ridge joined the one on which we stood, meeting it in a wide V, into which the wind blew. The effect was that of a huge chimney. The wind had no place to go except up. Over the point where the ridges joined, a steady and powerful column of air was swirling upward.

"The biggest 'chimney' I ever flew over," Bowlus said, "is at Point Loma, near San Diego." Point Loma is a long finger of ocean-battered sandstone that separates San Diego Bay from the Pacific. It towers from 450 to 750 feet above the sea. At one point on the ocean side, where the cliffs are half a thousand feet high, a small bay cuts into the peninsula. Into this 500-foot "chimney of rock" the sea wind blows. Students at the Bowlus school make their first soaring flights in the steady, rising currents above. On one Saturday afternoon, not long ago, seven students soloed "in the chimney," one after the other.

It was at Point Loma that the longest motorless flight of history was made a few months ago by Jack Barstow, chief instructor of the Bowlus school. When he took off, he had no idea of setting a record. He went aloft to test out the air currents. He found them so good he stayed up three hours for fun and kept on flying all afternoon and into the hours of the evening. At midnight he was still wheeling above the headland and the



Man's closest imitation of a bird is this 62-foot soaring plane, here poised on the ridge ready to take off.



Jordanoff in a glider is towed by an automobile. This is a dangerous sport, he tells gliders.

sea. When he passed the nine-hour record made by Bowlus, he called down to his friends, who had built bonfires on the cliffs to guide him, that he was going out after the world's record, fourteen hours and forty-five minutes.

He had brought along no food or extra clothing. He did not even have a cushion for the seat. Yet in spite of chill and hunger and fatigue he kept on until the wind died down, about four o'clock the following morning. He landed with the honor of having made the first fifteen-hour motorless flight in the world.

"It was like starting to walk to the store, and keeping on until you set a long-distance walking record," Bowlus said.

When Bowlus, himself, set his nine-hour record, early this year, he started out with the determination of staying up as long as the wind held out. And he did. He took along sandwiches and had a special zipper collar made which fitted around his neck and covered the cockpit. Thus he was able to ride out a storm.

For nearly five hours during this flight, he suffered from severe cramps in his legs. At times they were so bad he had to remove his feet from the rudder pedals and steer by reaching down and grasping the rudder wire with one hand. During the storm he was carried 1,500 feet above his starting point. The up-currents, pouring skyward from the 500-foot cliffs of Point Loma, were so powerful that the light machine sometimes sprang 500 feet upward in a single leap.

"What's the strongest wind a ship can soar in?" I asked.

"One has flown in winds that reached nearly sixty miles an hour. Dinort, the German, set his fourteen-hour-forty-five minute record in a fifty-mile-an-hour gale on the Baltic seacoast. Bad weather doesn't stop us as often as good weather. A perfect calm (Continued on page 122)

The great bird, with Jordanoff at the controls, wings its way back to the starting point at the end of his first cross-country flight.

He's glad he made it. Jordanoff was delighted when he found that it was possible to maneuver the plane back to the top of the ridge and make a perfect landing.

Taking Golf Swing Apart Shows Left Side Does It

1 Addressing ball. Note position of body in reference to the vertical line.

By ALEX J. MORRISON

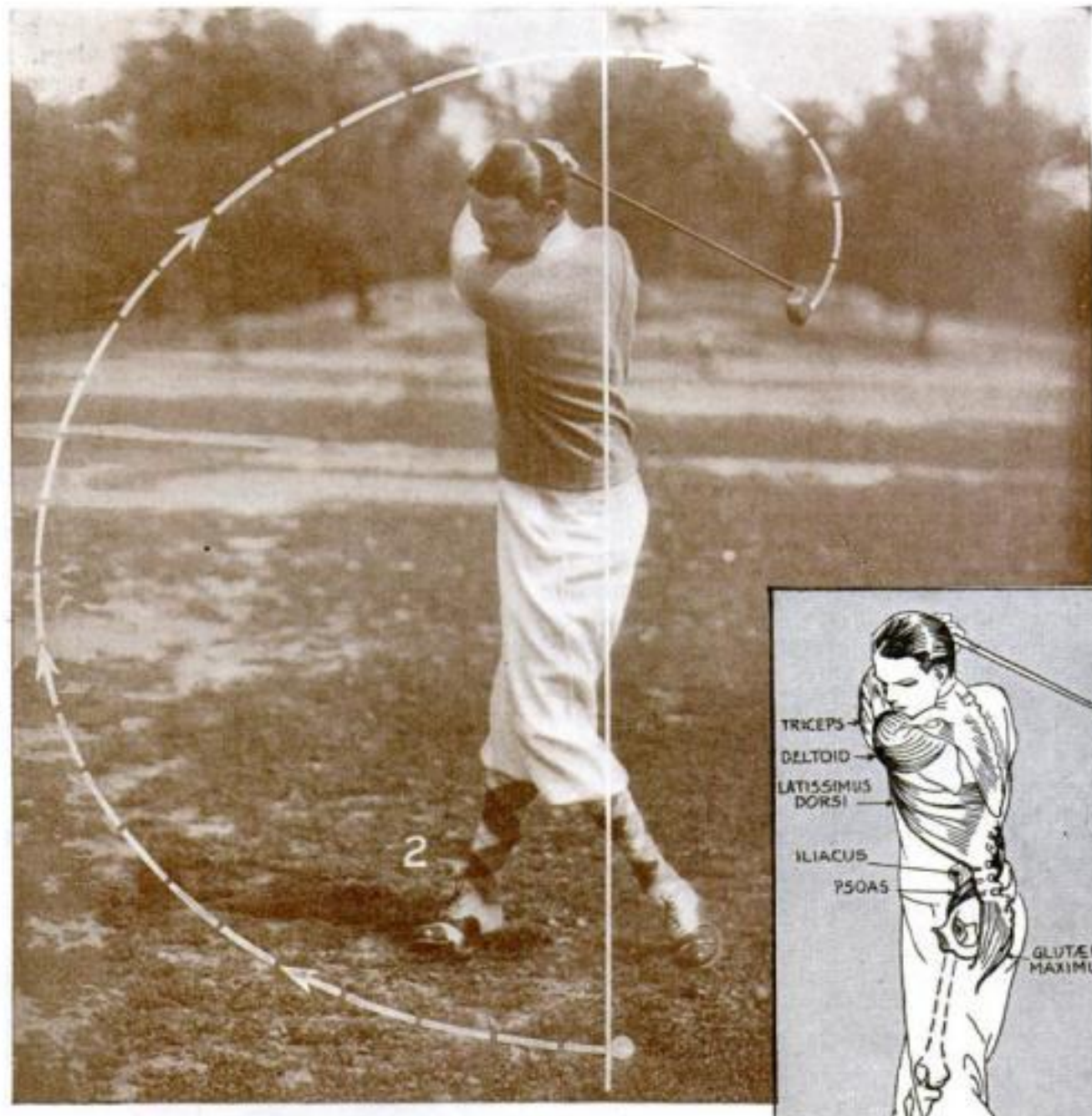
THE author of this article probably is the foremost authority on golf technique. He is the first man in the game's history who has fully analyzed the swing. He gives you here the scientific basis of every shot.

GOLF is popular mainly because it is a game by means of which every one, young and old, can enjoy complete mental and physical relaxation. But the player can enjoy this relaxation only when he uses the correct swing. This means that his body, his hands, his arms, and the club must be united in a harmonious action that will result in the club striking the ball in exactly the right way to propel it in the right path for the distance and direction desired.

The result of every shot in the game depends on the kind of swing that is made; and yet very few golfers at present make the correct swing.

This fact is the more surprising for the reason that the right swing is a perfectly simple and natural motion for any one to make regardless of age or size. Golfers, however, have come to regard the swinging of a club as so complicated an operation that most of them actually believe that a person either must be born with the ability to make a swing correctly or accidentally stumble onto the secret.

Ever since the game has been played, each method of swinging a golf club has been bolstered by many apparently sound arguments. These have been based almost entirely, however, on opinion and not on fact. In this explanation of the correct golf swing, I shall



2 At top of swing. Weight is on the right leg and muscles are coiling backward from left hand to shoulder.

Diagram shows muscles of the left side used in first half of the swing.

3 Bringing club down. Force flows from the back through left arm.

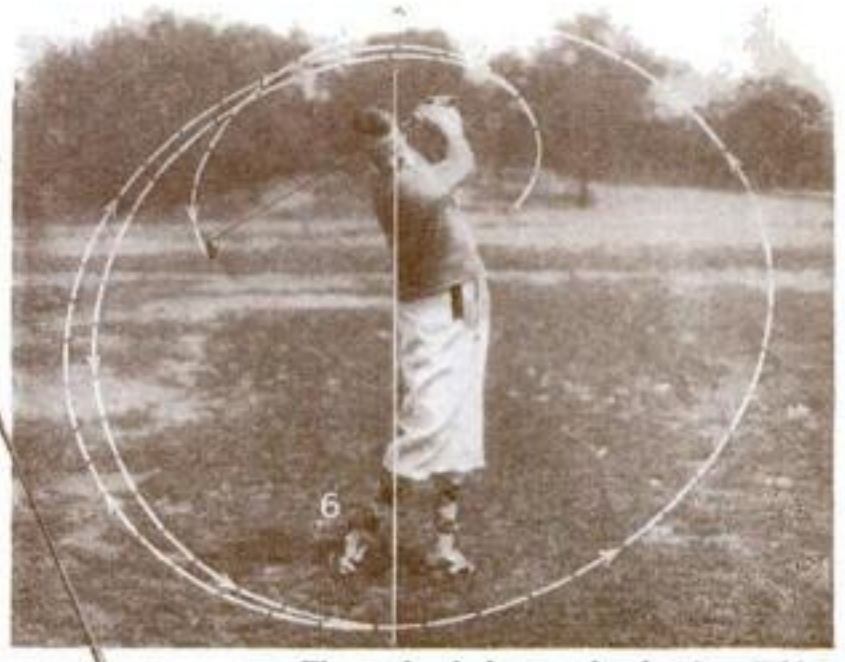
confine myself entirely to facts—facts whose truth I have established by study of the mechanical, anatomical, and mental factors involved, as well as by practical application, as player and teacher, of the principles which I have found govern the making of the correct swing.

The correct swing can be defined in a few words: One full, smooth, flowing motion without mental or physical interruption. This continuous motion moves the club so that the path traversed by its head is both accurate and consistent, affording maximum efficiency in projecting the ball where the player wants it to go.

THE correct swing, as I have defined it, and the necessary freedom of motion, cannot be had when the player grabs the club as he would a baseball bat, pressing the thumbs against the grip so that the muscles of his wrists and forearms are locked tightly. It cannot be made when the player grips the ground with his feet, thereby tightening the muscles of his legs; or, worse still, when he tries to keep his body still, or in a fixed position, and so contrives to tighten up the muscles of his back. It is fatal to the swing if any of the muscles are locked against the flowing motion of the club. Instead of following the proper method of eliminating mental and physical tension, the player has to do something to control the muscular tension caused by his incorrect position.

The correct swing and the use of the muscles that are being described will depend first of all on the manner in which the player grips the club, the position in which he places his feet in relation to the ball and the line of flight, and particularly to the position of his spinal column. The correct action of the muscles in the hands and arms can be had only when the club is held in the palm of the left hand and in the fingers of the right hand. The right little finger interlocks with the left forefinger and the main pressure is felt in the left little finger and between the right forefinger and thumb. Both hands should be at exactly the same angle to the shaft of the club. This is the only position that will afford unison of wrist action, which is vitally important to the making of the correct swing. The ball should be opposite the heel of the left foot and the feet placed with the toes turned slightly outward and on a line about parallel to the direction desired. The player should at all times stand as erect as possible so that a side to side motion of the hips can take place.

5 After the blow is struck. Only momentum sends the club along after the moment of impact.



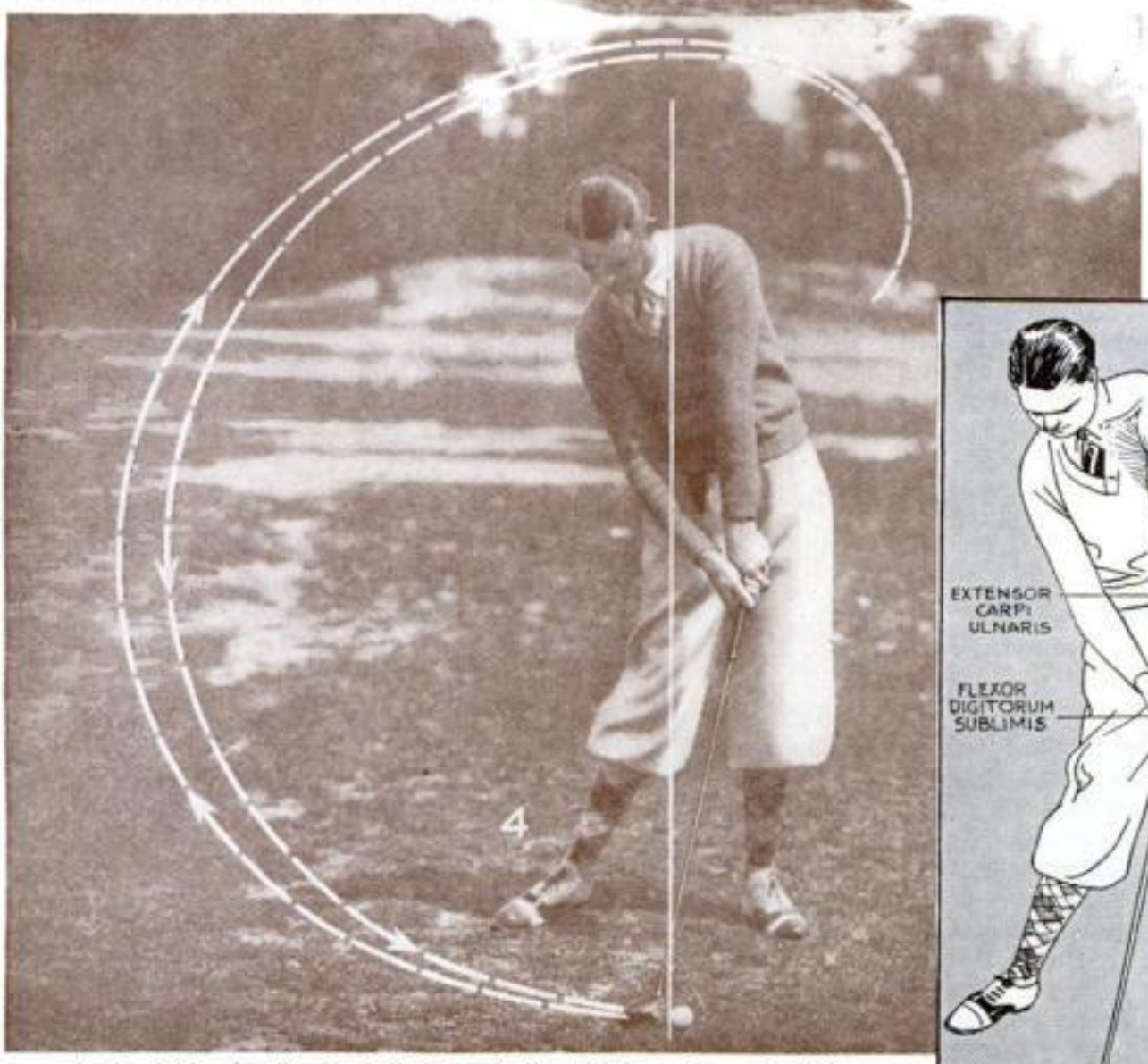
6 The path of the completed swing. White lines shows exactly how clubhead traveled.

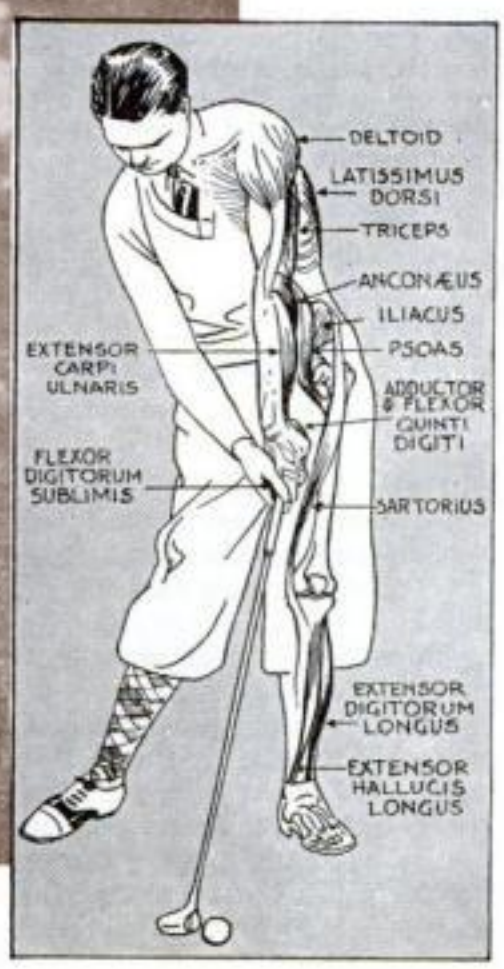
MENTAL and physical tension frequently arise from the player's worry over the possible outcome of his shot. If he is doubtful whether the ball will travel far enough to "carry" over various obstacles, natural and artificial, that he sees before him on the course, he inevitably will tighten up at some stage in the process of his swing.

In some golf shots the ball is required to travel more than 200 yards in the air, necessitating considerable force in the swing as the clubhead meets the ball. When making most shots the thought of hitting the ball hard enough is generally uppermost in the golfer's mind, and this produces a tension that makes it impossible for him to meet all the mechanical requirements of the swing.

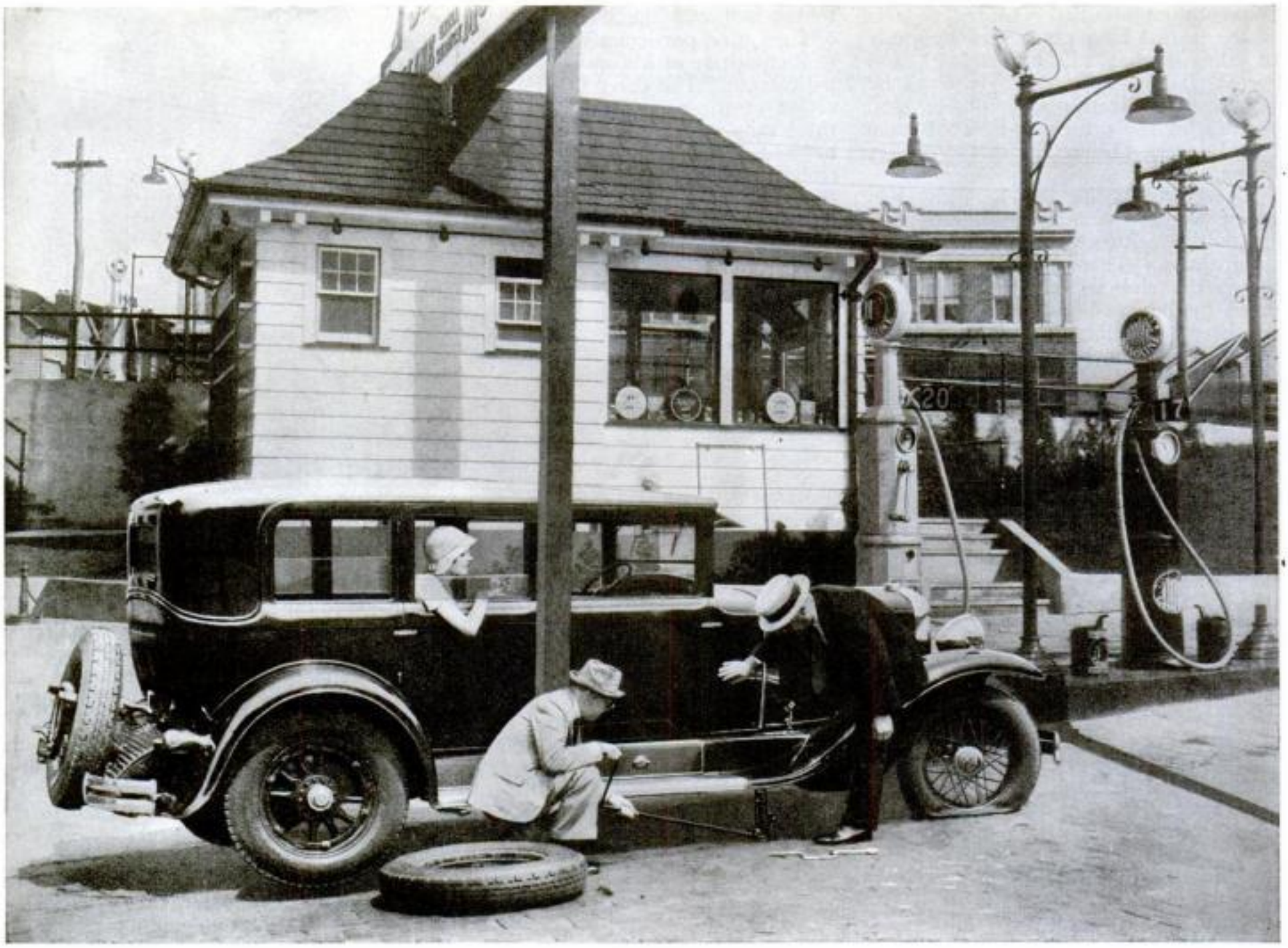
Also the player may spoil the swing by incorrect motion of his body from side to side, up and down, or back and forth in relation to the ball. Or he may use a club of the wrong length or the wrong weight or with its head set at the wrong angle for making the particular shot required. Any one who has tried to hit a golf ball into the air so that it will land on a given spot will testify to the difficulties experienced with some or all

(Continued on page 131)





4 As the clubhead strikes the ball. Note the line of balance shows the body has moved well to the left of the original position in stance. Diagram at the right gives a clear idea of the muscles that give force to the stroke.



Can The Camera Lie?

A Great New "What's Wrong" Contest

$1,000 a Month In Cash Prizes

Beginning next month, in the October issue, and continuing for four months, POPULAR SCIENCE MONTHLY will conduct a new kind of picture contest—a fascinating game that will test your powers of observation and your supply of common sense.

You will have a lot of fun and a chance to win one of the big cash prizes. There will be sixty-three (63) prizes each month as follows:

First Prize	**$500**
Second Prize	**100**
Third Prize	**50**
10 Prizes, $10 each	**100**
50 Prizes, $5 each	**250**
Total, each month	**$1,000**

Thus, in the four months of the contest, there will be 252 prizes with a total value of $4,000 in cash. You have as good a chance as anybody else to win a prize. To compete, you need only be alert and observant.

The contest revolves about the unhappy experiences of George Knowitall whom we introduce to you in the picture above. George is one of those cheerful enthusiasts who will show a carpenter how to hit a nail or a chauffeur how to drive a car.

Study the picture on this page. This is a sample picture and is NOT part of the contest, which begins next month. Obviously it is a photograph, but did you ever see a camera lie so outrageously? This is one of the unique features of this fascinating contest: the adventures of George Knowitall will be told entirely by *trick photography*. We might have engaged an artist to draw pictures of George, but artists sometimes make unintentional mistakes. The camera, though, never lies—unless the photographer wants it to. So in the contest pictures, when you find a mistake, you may be sure that it is a mistake, made intentionally, put there just so you can find it.

In the picture above George has volunteered to change a tire on his friend's car and is making a mistake. *What is it?* But that is not all. Our camera has made 16 deliberate errors. For example, the owner of the car has only one leg. There are four spokes missing from the rear wheel of the car, which also has no brake drum. See if you can find the other 13 mistakes. Then turn to page 134 where the errors are listed.

In the October, November, December, and January issues we will print 16 similar trick-photography pictures, four in each issue. In every picture George Knowitall will make a mistake, and there will be exactly *four* camera errors. Of course, after the contest opens, we will not tell you what the mistakes are.

Watch for the October issue which will contain the complete rules of the contest and the first four contest pictures. Each contest will be complete in itself and there will be sixty-three (63) cash prizes, totaling $1,000, each month.

Sixty-three (63) Cash Prizes Totaling $1,000, Each Month

How to Get an Air-Tight Patent

Capable attorney, courage, and good judgment needed if inventor's struggle is to win success. A noted patent lawyer tells in this article how costly blunders may be avoided.

By

EDWARD THOMAS

Many an inventor has seen the products of his genius develop into great commercial successes in which he has not shared because he has failed to protect his inventions in the proper way.

CONGRESS' penny-wise and pound-foolish dealings with the United States Patent Office, resulting in unnecessary and interminable delays (P.S.M., June '30, p. 20), have thrown a monkey wrench into the machinery of American progress. But the inventor must not allow himself to be discouraged. While wrestling with the Patent Office, he should not permit his exasperation at the delays to divert his attention from the necessity of getting a *good* patent if his invention is to be worth anything to him and to the world.

First of all, he must make sure that the valuable part of his invention is not given away for nothing in his patent. My experience has shown me that more money is lost by inventions given away in patents poorly drawn by incompetent attorneys than is lost through the inventions stolen and delays at the Patent Office.

Take the case of Ben Hicks, a Virginia negro who can neither read nor write but who undoubtedly is an inventive genius. Some years ago he built a machine for removing the stems and dirt from peanuts. He obtained a patent on the device, but it failed to show the shaking of a trough, which held the peanuts, in such a way as to make possible the cutting of the stems by saws. So far as I could learn this patent was absolutely worthless because the machine shown in the patent without the shaking of the trough would have been useless. Manufacturers, seeing the value of the device, began to make it without paying Hicks royalties, or profits.

A few years later, another man, named Benthall, filed a patent application on a peanut stemming machine and showed the shaking trough. He received his patent and then sued the manufacturers who had been building the machines. Of course, Benthall's patent was held to be void by the court because Ben Hicks's device of the shaking trough had been in public use. Thus Hicks, who should have earned a fortune from his invention, received nothing. His invention was not stolen in any ordinary sense of the word, but his patent attorney was incompetent.

THIS attorney probably was responsible for a mistake which is made by most inventors and many attorneys who assume that the specification of the patent—the description of the invention—should be as sketchy as possible. In reality, the specification is the heart and soul of the patent. It should completely describe every detail.

Not long ago, an inventor applied for a patent on a system of refrigeration for railroads whereby an entire train, in effect, was made into a single refrigerator. The Patent Office found that the only novel part was a new form of valve for connecting the various refrigerating units.

NOW, in this case a specification describing fully every detail of the mechanism secured for the inventor a valuable patent on a part of his invention which he regarded as unimportant or even obvious. Other inventors long ago had solved the part of the problem which he considered difficult, but they failed to see the other, apparently minor problem which he also solved. Before the law, the one small detail constituted the only new invention in this case.

But even if a patent has a good specification, it may give away the invention in the claims, which are the definitions of the invention.

A valuable invention in typewriters was given away in the claims by the attorney who handled the patent application. A man named Grundy, living in what now is part of New York City, had designed the first visible writing typewriter with what is called a vibrating rib-

Lack of determination has killed many excellent ideas. This inventor of an automobile lamp was unhesitatingly turned down by the first manufacturer to whom he took it. Undiscouraged, he showed his lamp to others who purchased part interest in it and then the first man bought at a high price.

bon; in other words, a ribbon which is normally out of sight or away from the printing line, but which rises to the printing line every time a key is struck so that the type will print in the usual way by means of the ribbon.

The attorney limited the claims of that patent to a typewriter which vibrated the ribbon by tilting the ribbon spools. Of course, no typewriter manufacturer wanted to tilt the spools, so the patent gave away, for nothing, the idea of the vibrating ribbon. If the patent had contained claims covering only the lifting of the ribbon to printing position, it probably would have brought in a royalty of a dollar a machine to a possible total of half a million or a million dollars before the patent expired.

Other valuable inventions have been given away by poor business judgment. One of these was what is known as an accelerator for causing rubber to vulcanize more rapidly and more effectively. Kratz, the inventor of this accelerator, thought it could be made only from expensive materials, and he or his employers decided not to patent it, although he read a paper describing it before the American Chemical Society and also sold experimental rubber tubes manufactured by means of its aid.

Later a chemist named Weiss discovered a method of manufacturing cheaply the same accelerator, and obtained patents both on the manufacturing method and on the use of the accelerator in vulcanizing rubber. Weiss's patent on vulcanization was held void, and the world received the benefit of Kratz's paper for nothing, although it has been estimated that the invention, on a royalty basis, would have brought in $3,000,000!

COURAGE is just as essential to the successful inventor as vision and imagination. The courageous inventor is not discouraged by the bad business judgment of those to whom he first tries to sell his invention. Some time ago the inventor of a new electric lamp for automobiles submitted his invention to one of the world's largest lamp manufacturing companies. This concern turned it down. But the inventor did not lose heart. He went to a leading automobile manufacturer, who immediately saw the possibilities and made it the standard lamp on his cars.

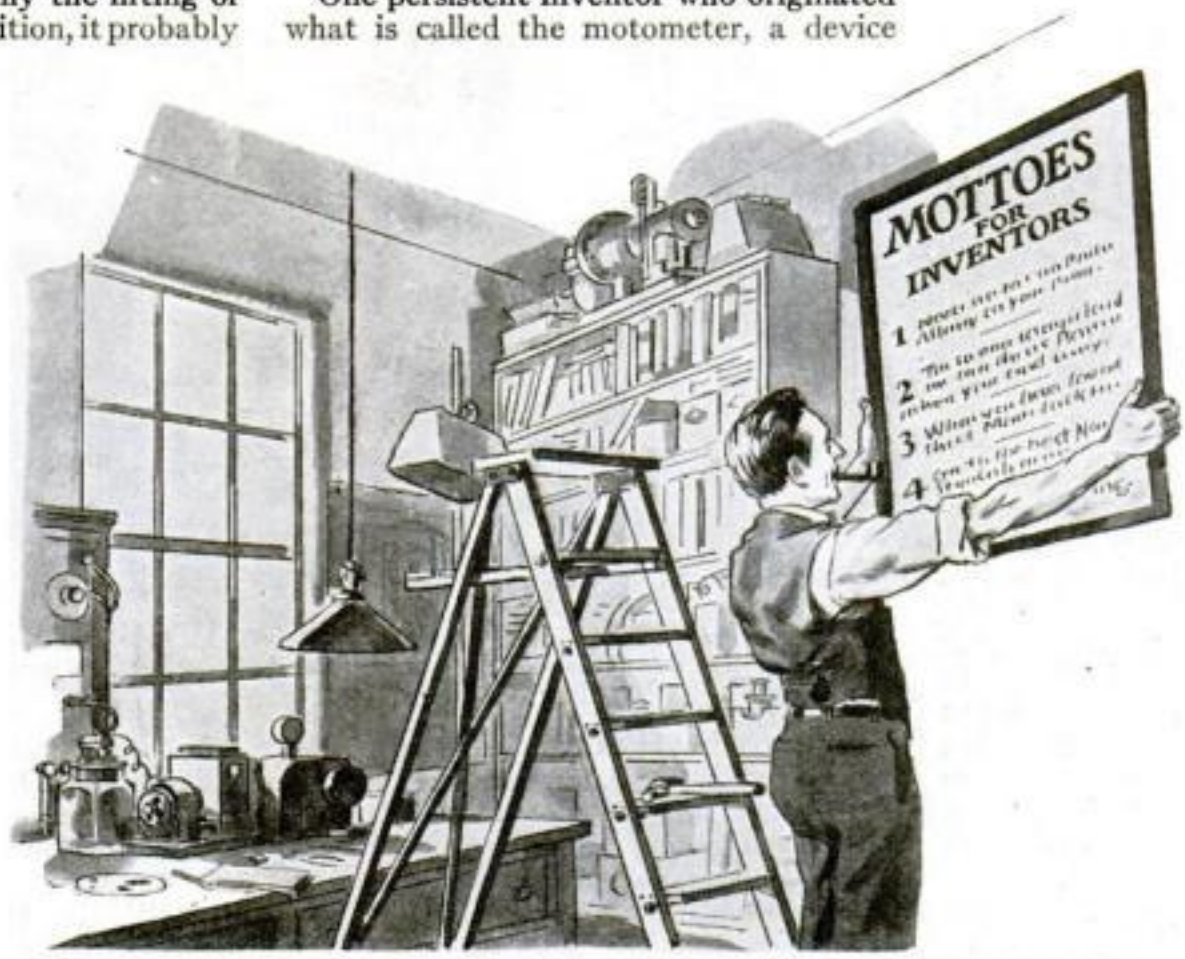
This manufacturer naturally was not equipped to make the lamps himself. Armed with an order from the automobile maker, the inventor went to a second lamp company to have them manufactured, and sold it a small interest in his invention for $25,000. A third lamp manufacturer, learning of the success of the new lights on the cars, paid $40,000 for another small interest. By this time, the first lamp company repented of its decision and paid several hundred thousand dollars for the remaining rights!

THAT inventor is now a rich man because he refused to bow to the discouraging decision of the first business organization to which he took his invention. Other inventors have become wealthy by refusing to be put off by the first attorney they consulted.

One persistent inventor who originated what is called the motometer, a device indicating when the water in an automobile radiator is overheated, refused to be discouraged when several attorneys declined to take up his invention on a contingent fee, or profit-sharing basis. One attorney is said to have refused to handle it even on a fifty-fifty basis. But finally the inventor found an attorney willing to take it up, possibly on that basis, and the patent on the invention is believed to have netted several hundred thousand dollars in royalties.

That inventor was wiser than a chemist with a process for producing cheaply a rich but crude industrial alcohol, who was sent to me some years ago by a mutual acquaintance. I saw that his invention probably was very valuable, barring the chance of having been anticipated in some foreign publication, and barring the chance of an interference, or legal fight (P.S.M., July '30, p. 44), with a rival American inventor.

THEREFORE, I offered to handle the patent application for him and to try to sell the patent on a basis of twenty-five percent of the proceeds. He was unwilling to pay more than five percent, and could not get any other attorney to offer better terms than mine. That chemist is now a poor man. Probably his invention is of no value at present because in the meantime the same ground has been covered by other inventors. Today I would not take his invention on any contingent basis.



Four rules of success: An honest and capable attorney, good business judgment, an abiding faith in the invention, and, last, persistence in spite of discriminating Patent Office red tape.

But courage, persistence, and a willingness to deal liberally with a competent attorney are not enough. The inventor also must possess discretion. He must look before he leaps into a business deal. He must not allow the prospect of big profits to lead him to entrust his invention to irresponsible parties.

Take, for example, the case of a young radio inventor for whom I prepared a patent application not long ago. The invention seemed most remarkable. With only two tubes he was able to receive California broadcasts in his home, although he lived in New York City between two of the elevated railroads whose ironwork necessarily interfered with the reception. To tell the truth, none of us, not even the inventor himself, knew why the apparatus worked as wonderfully as it did. But of one thing we were sure, it did work! To enable me to prepare the proper specification, I had him experiment with modified forms of the device. These experiments threw sufficient light on the underlying principles to enable me to draft satisfactory specification and claims.

Before obtaining the patent, he tried, as is usually advisable, to dispose of his invention. He fell in with some plausible fellows who appeared to represent an enterprising new radio supply company. To them he sold what is known as an option—that is, they paid him a sum of money for the exclusive privilege to buy the invention outright at some future date.

Some months later, he was dumfounded to read in the newspapers that the district attorney was investigating the dealings of the company and that the postal authorities had denied it the use of the mails. Meanwhile, the promoters had sold stock to the public on what the newspapers said was a fraudulent basis, and as long as the option was in force this amounted to selling stock in my client's invention. The option is still in force, the company is still under investigation, and the young inventor is unable to dispose of his work to anybody else.

Finally, to win fame or fortune an inventor must be sure that his invention fits into the machinery of progress in his own day. It is just as fatal to be too far in advance of one's period and environment as it is to be behind the times.

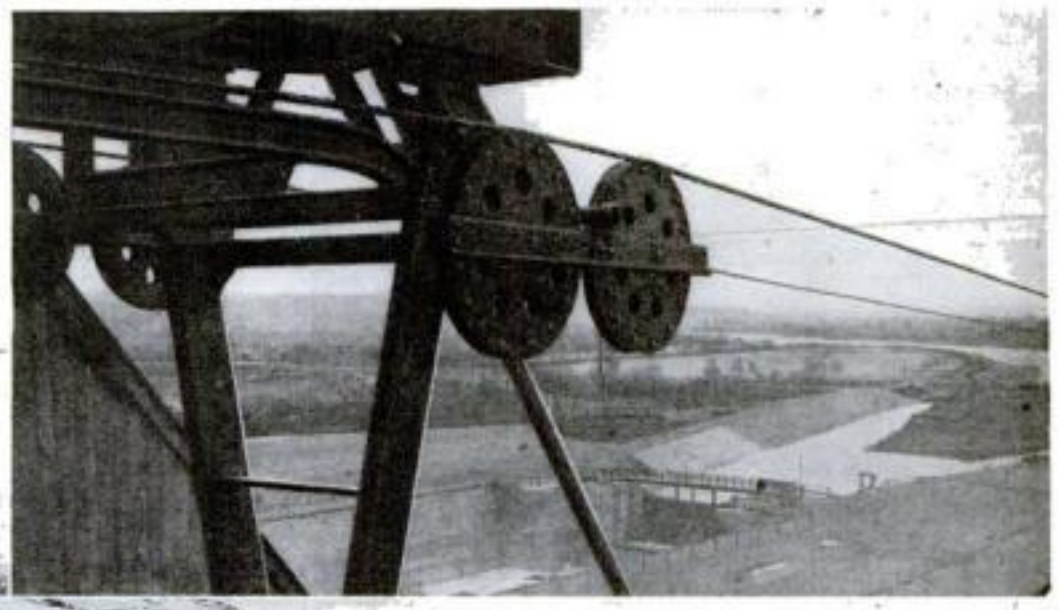
An inventor may be so far in the lead that his invention for a while sits idly on what might be called the shelves of the museum of scientific curiosities, while other inventors, perhaps less original and far-seeing, receive credit for the inventive progress of the world.

As everyone knows, George Stephenson, the English (Continued on page 134)

PROGRESS AND DISCOVERY

Important achievements in engineering, exploration, and discovery, and the latest news of the world's progress in science

"I take many pointers from them for my lecture work," a professional lecturer of Milwaukee, Wis., says of these pages. Here you will find the thrilling stories that watchful POPULAR SCIENCE correspondents send us from all over the world, wherever men are doing unusual things in unusual and original ways.



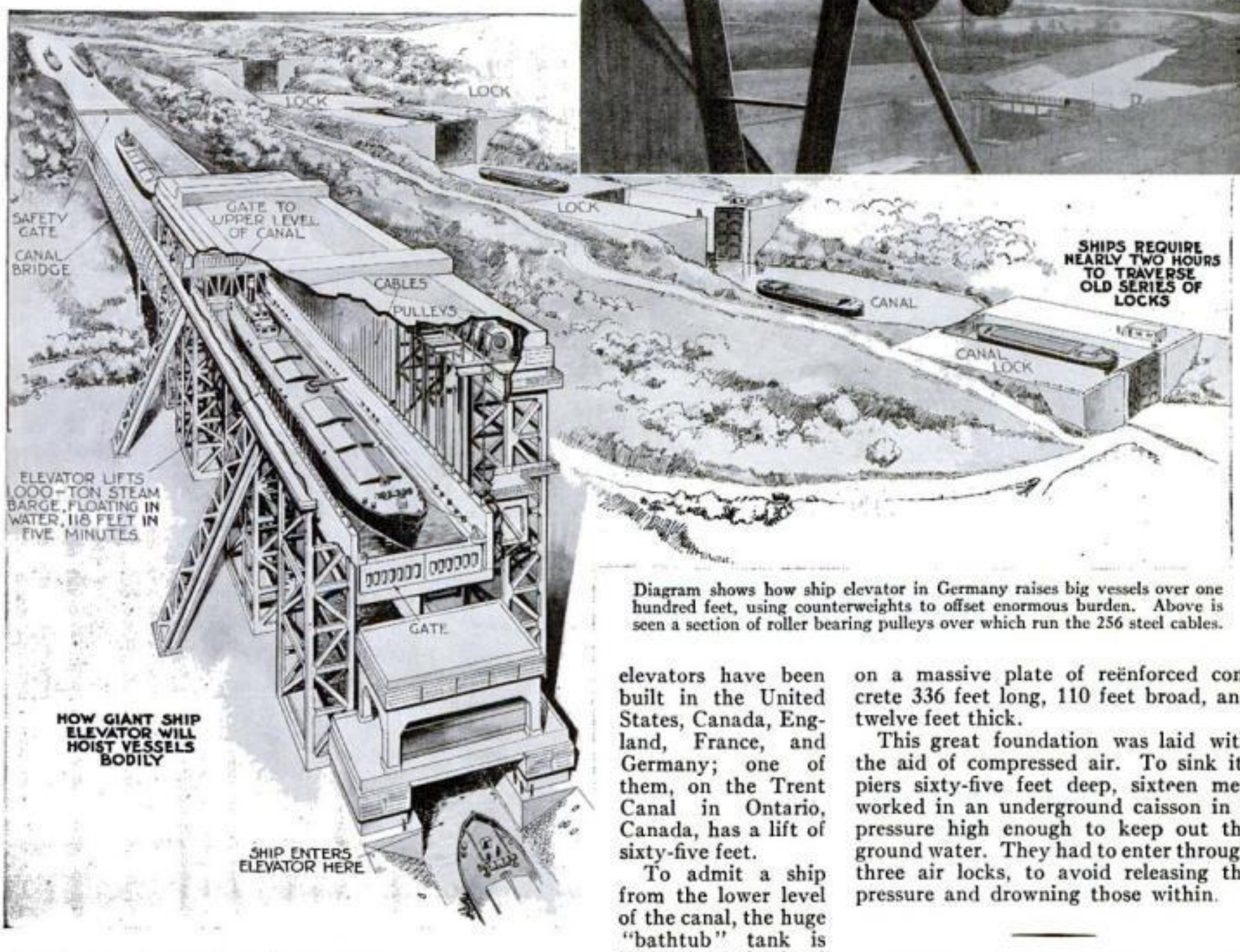


Diagram shows how ship elevator in Germany raises big vessels over one hundred feet, using counterweights to offset enormous burden. Above is seen a section of roller bearing pulleys over which run the 256 steel cables.

CANAL SHIP RAISED 118 FEET IN FIVE MINUTES

THE greatest ship elevator in the world is nearing completion at Niederfinow, Germany. When finished, it will hoist thousand-ton boats higher than surrounding tree tops, as easily as if they were toy boats in a bathtub.

This structure, of which the foundation has just been completed and which is expected to be in use by 1934, will replace a series of locks in the ship canal that links Berlin with the port of Stettin and the Baltic Sea. It will enable ships to make in five minutes a 118-foot ascent that formerly required nearly two hours.

The idea of lifting a ship bodily, in a tank of water, is not new. Smaller ship elevators have been built in the United States, Canada, England, France, and Germany; one of them, on the Trent Canal in Ontario, Canada, has a lift of sixty-five feet.

To admit a ship from the lower level of the canal, the huge "bathtub" tank is lowered to the level of the entrance, and its front gate opened. The barge then steams slowly into the chamber, which is 280 feet long and thirty-eight and one half feet wide. It can accommodate one 1,000-ton barge or four smaller canal ships.

When the vessel has entered the tank, where it floats in eight feet of water, the entrance gate is closed. Then motors are started and the great tank, with ship, water, and all, starts on a journey that takes it as high as a ten-story building.

Counterweights, supporting the tank by 256 cables running over roller bearing pulleys, balance its weight so only 300 horsepower is required to lift it. Normally, with water and vessel, the tank weighs about 4,250 tons. The weight is supported by a steel framework, resting on a massive plate of reënforced concrete 336 feet long, 110 feet broad, and twelve feet thick.

This great foundation was laid with the aid of compressed air. To sink its piers sixty-five feet deep, sixteen men worked in an underground caisson in a pressure high enough to keep out the ground water. They had to enter through three air locks, to avoid releasing the pressure and drowning those within.

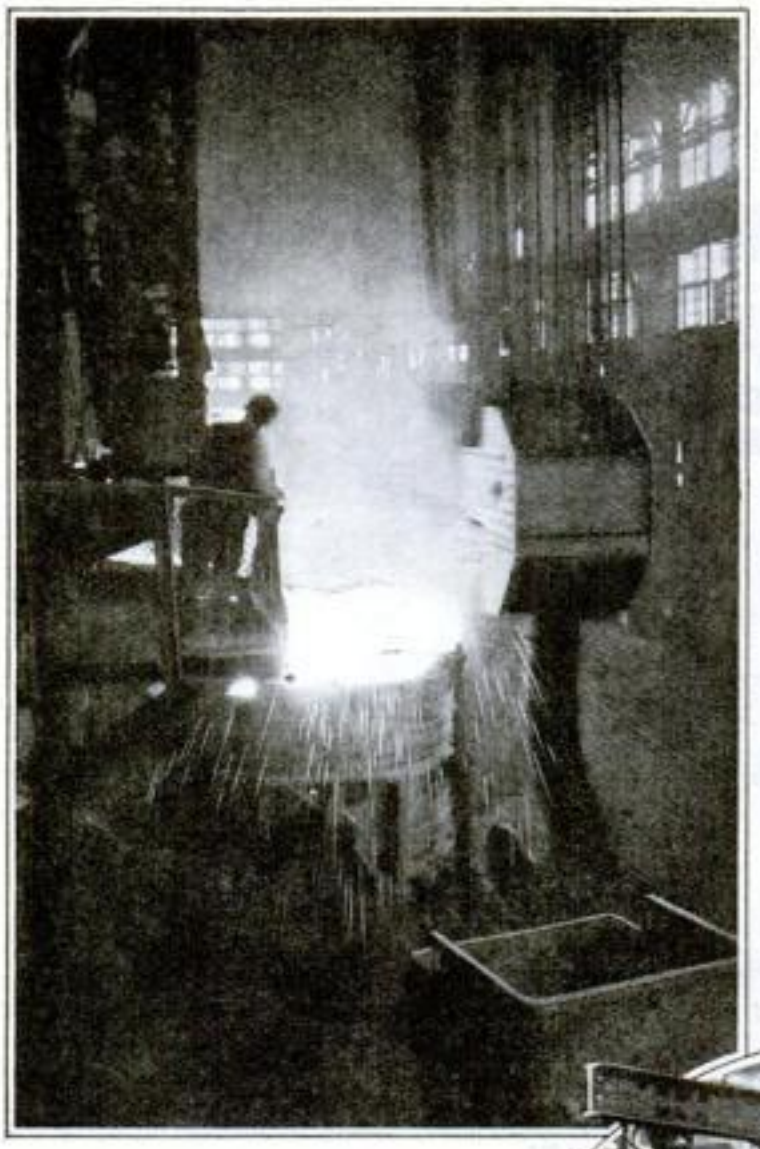
PLOWING GROUND ENDS KANSAS MIRAGES

PLOW the land, and mirages disappear. That is the conclusion drawn from the present rarity of these illusions in the western part of Kansas.

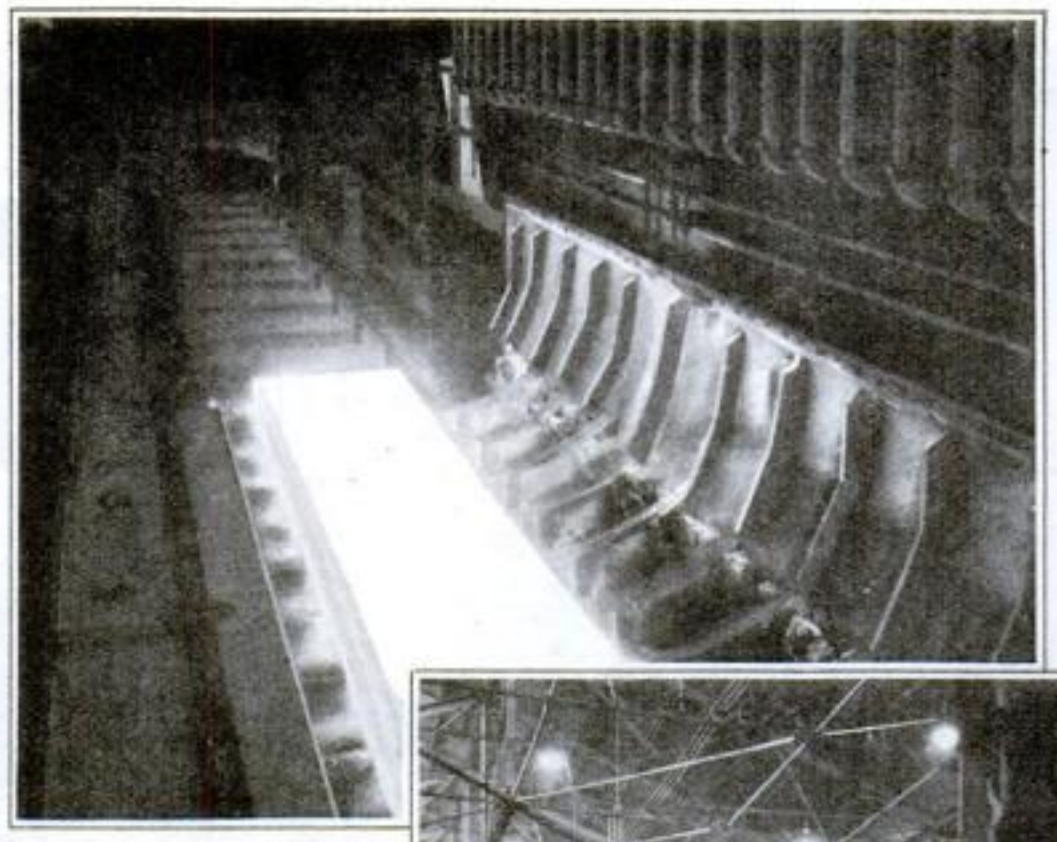
Only a few mirages have been seen this year, near the Kansas town of Sublette. Formerly it was not unusual to see apparent bodies of water in the distance, surrounded by boathouses, cottages, and towers.

Plowing the land is thought to have caused the change. Mirages of this type result from the reflection of light upon the surface of shallow layers of superheated air. Breaking up the soil prevents the formation of these air layers.

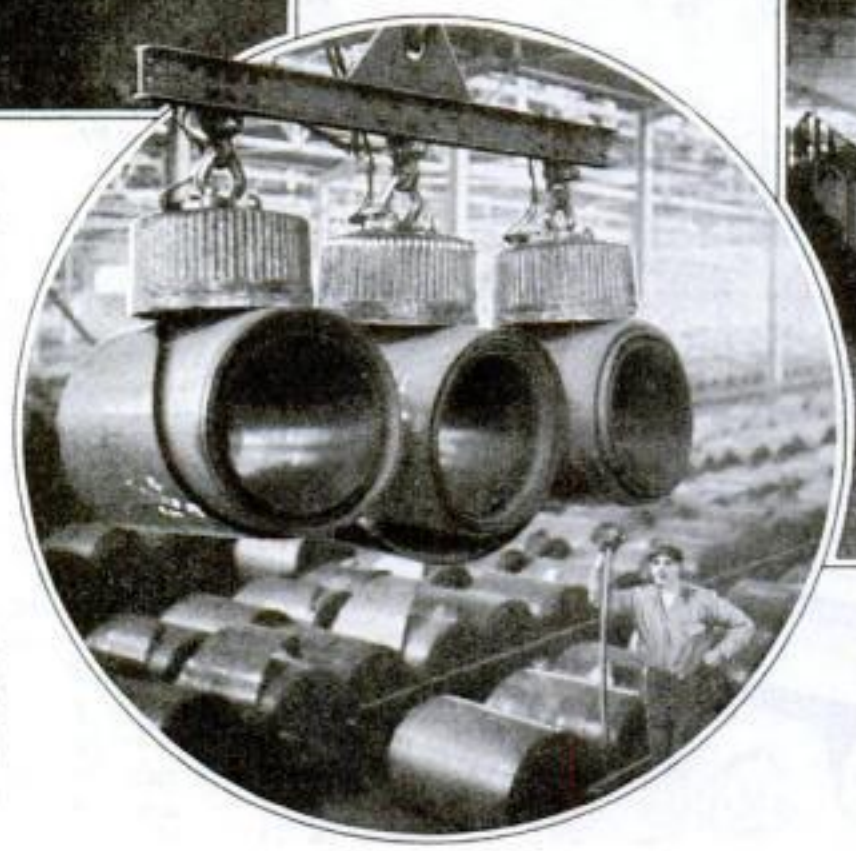
Views of Progress Caught by Our Camera Men



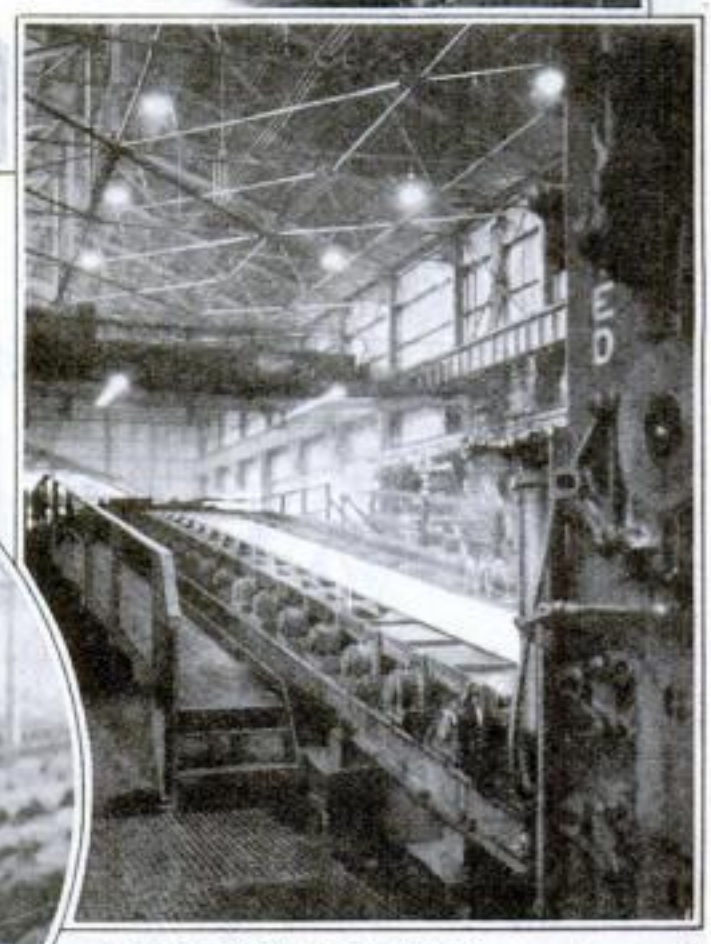
NEW SHEET STEEL PROCESS. Kitchens, bathrooms, and whole houses of sheet steel, and hundreds of other new uses, are foreseen with success of a new continuous rolling mill at Middletown, O. Photos show how 11,000-pound ingots are reduced to sheet metal at rate of over a ton a minute after passing along 800-foot line of machinery suggesting an automobile factory assembly line. Above, tapping open-hearth furnace.



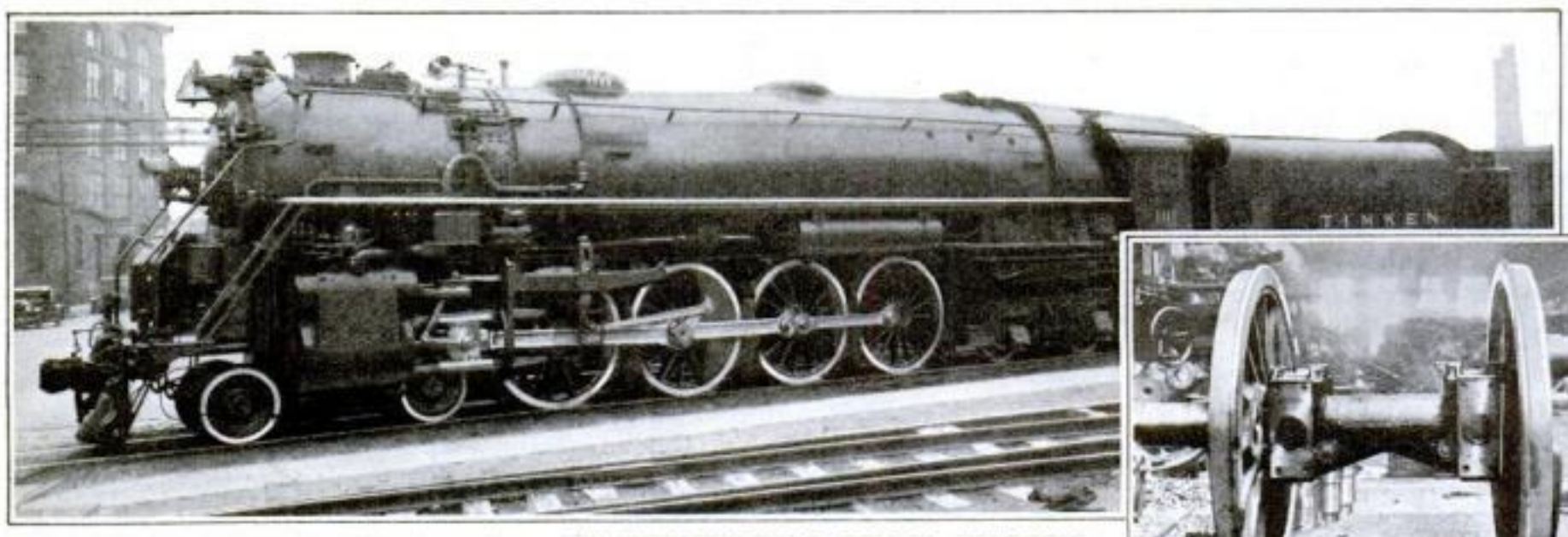
START OF METAL SLAB. The 11,000-pound ingot starts through the continuous mill. Passing through great rolls, it emerges as a red ribbon.



READY FOR THE SHEARS. At the end of the 800-foot line, the ribbons of steel, automatically coiled, are delivered to the cutting room by these huge lifting magnets. There they will be unrolled, cut to commercial length, and shipped.



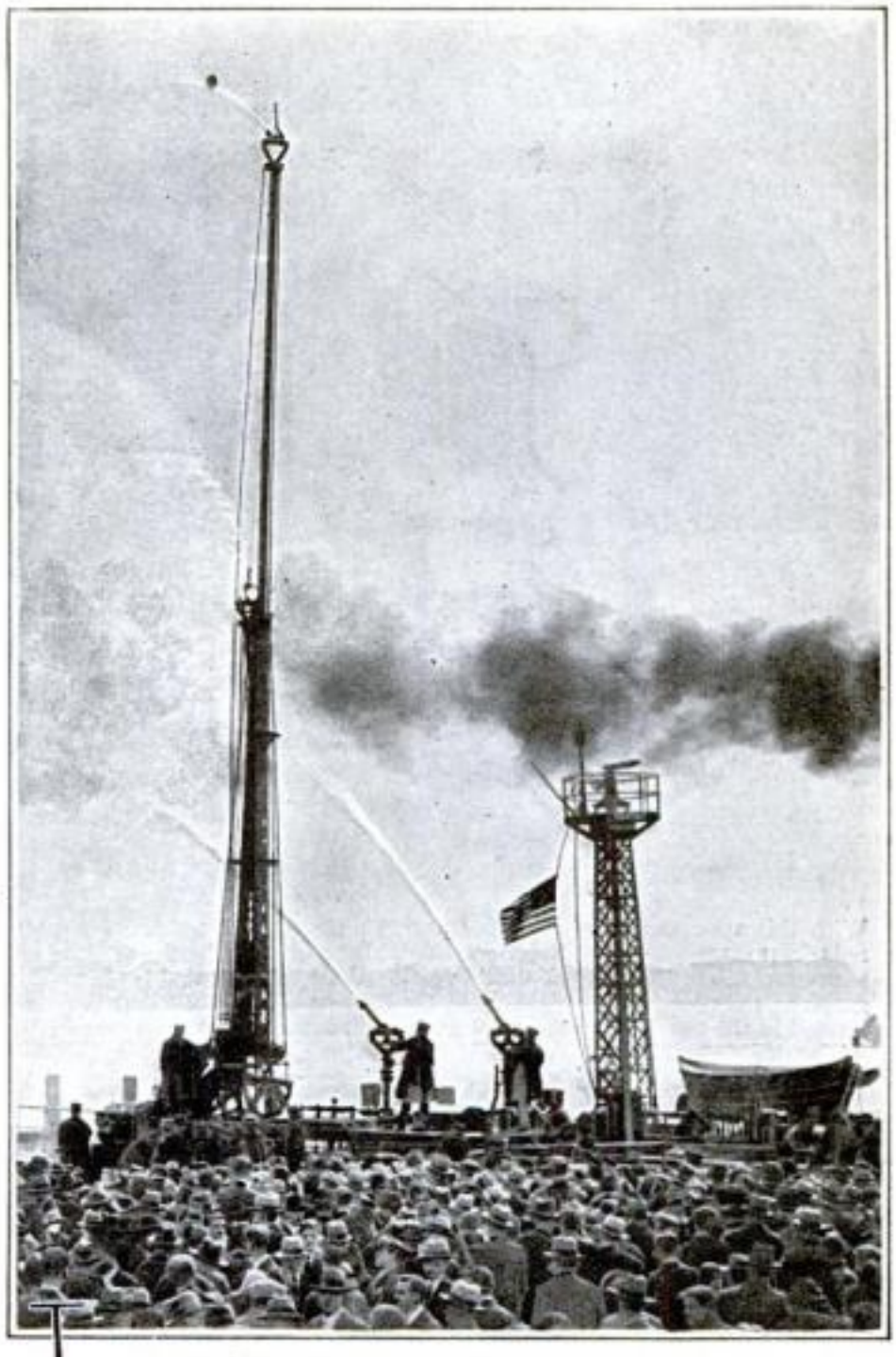
REDUCED TO A SHEET. In twenty seconds the massive ingot has been rolled to 200 feet of sheet metal. A man must run to keep up with its journey through the mill. This speed makes cheap, mass production for new uses possible. For example, school blackboards are now being made of large metal sheets faced with green porcelain. Roofing tile of metal has appeared, also coated with porcelain of various colors.



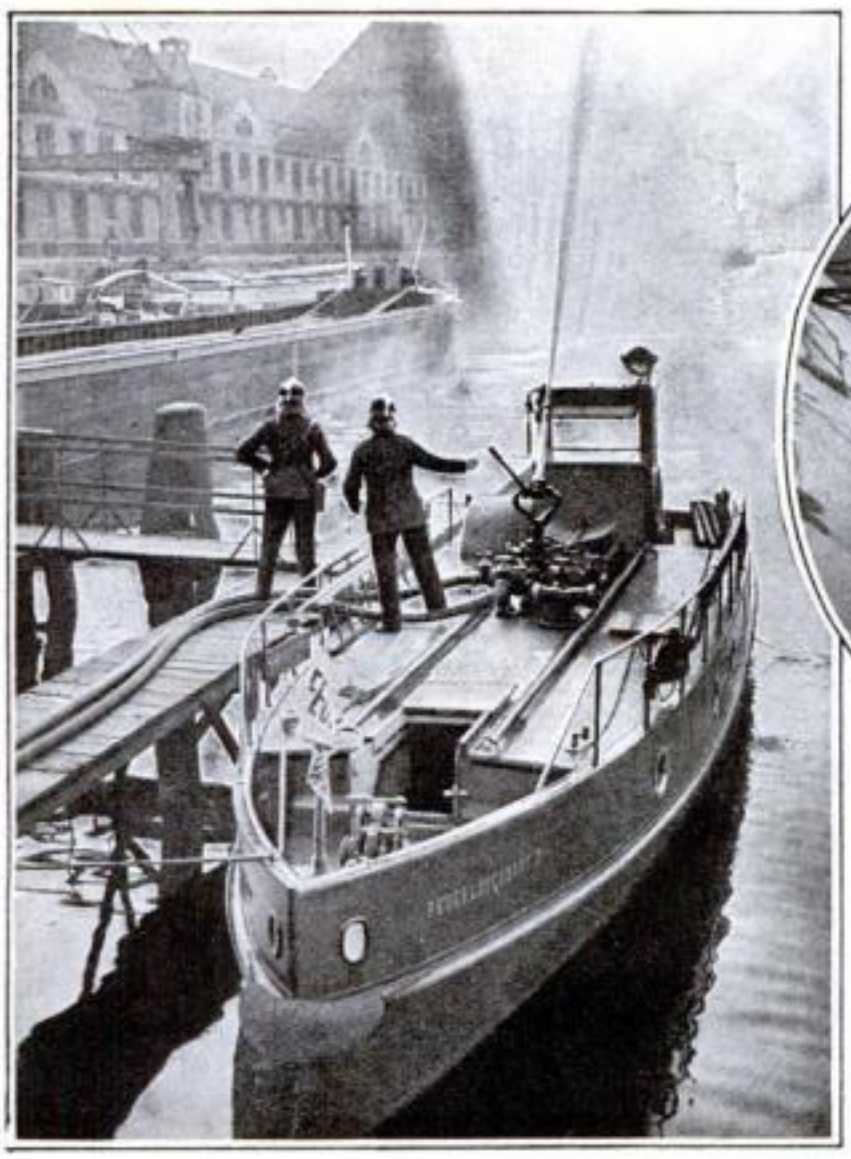
A GIANT ON ROLLERS. This locomotive, weighing more than two hundred tons, rests on roller bearings similar to those used in automobiles.

TWENTY-TWO-INCH ROLLER BEARINGS. At right is a close-up of a pair of drivers, showing the one-piece housing inside which are the bearings.

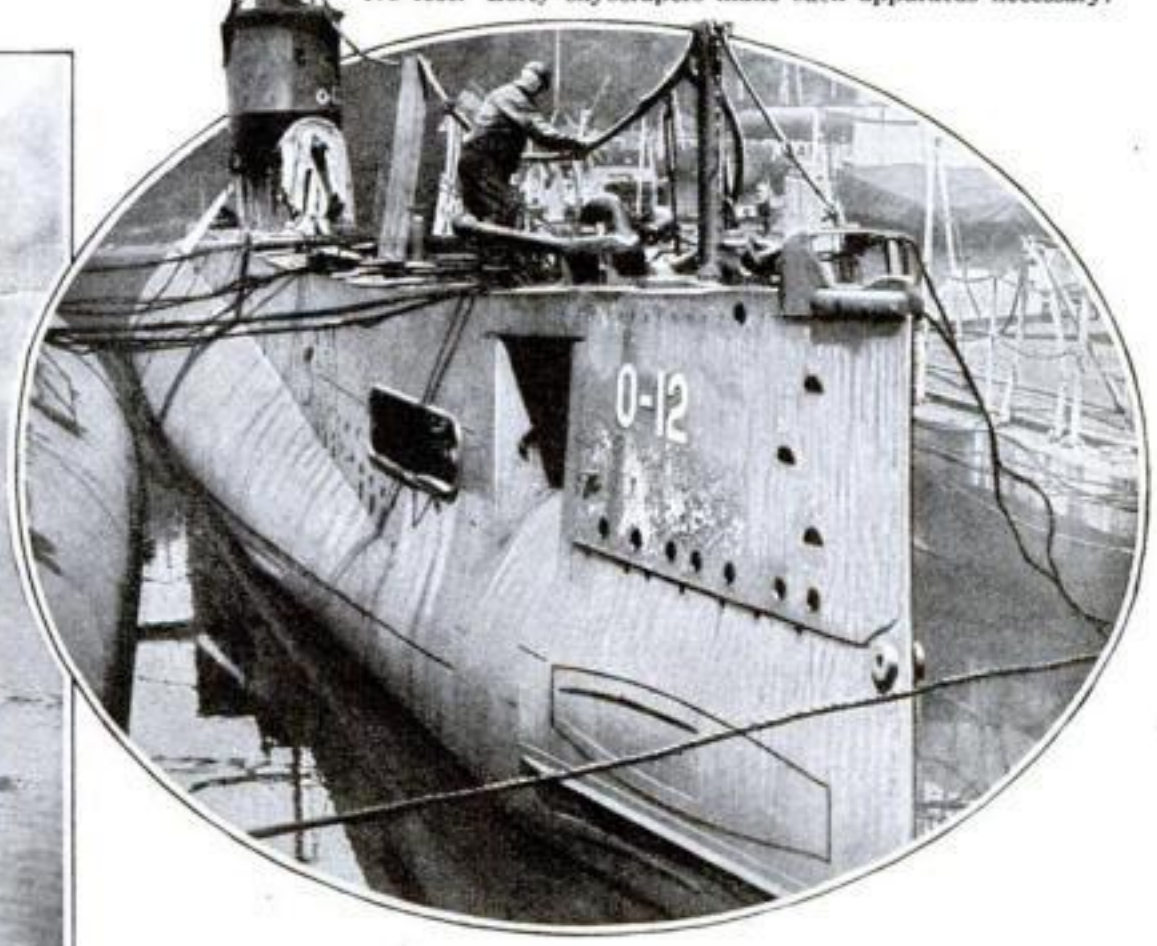
STREAMLINED FOR SPEED. Here is the *James Archibald* coming straight at you. It is a huge new freight engine built for the Delaware and Hudson Railroad in New York State. In addition to the streamlined design, note that it has a hidden smokestack with the bell tucked in front of it and a built-in headlight. The boiler is intended to withstand a steam pressure of 500 pounds to the square inch, twice that of most engines, and is expected to save fuel.



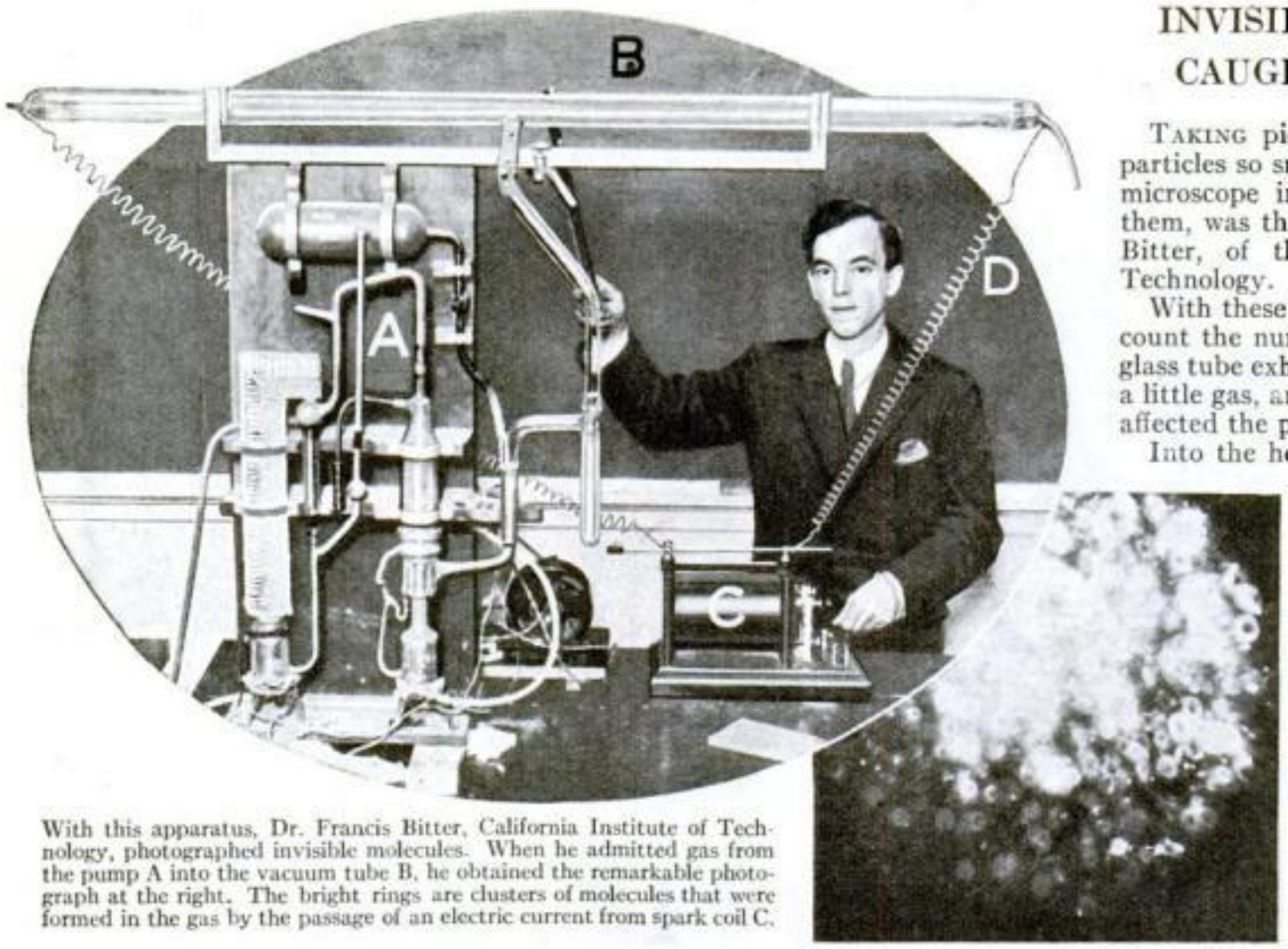
WATER TOWER FOR SKYSCRAPER FIRES. This sixty-five-foot water tower was demonstrated recently at the Battery, New York City. It is equipped with four nozzles capable of throwing 28,000 gallons of water a minute a distance of 175 feet. Lofty skyscrapers make such apparatus necessary.



TINY BOATS FIGHT FIRES. Germany has developed midget fire boats that are capable of great speed and which are equipped with powerful engines that throw long streams of water from single nozzles. Numerous waterways make these fire fighters most effective in putting out blazes.



TO DIVE FOR NORTH POLE. Permission has been granted to the famous polar explorer, Sir George Hubert Wilkins, to use the United States Navy submarine *O-12* in an effort to reach the North Pole by traveling beneath the Arctic ice floe. Devices for boring through fifty feet of ice will be installed in the boat, as well as radio apparatus.



With this apparatus, Dr. Francis Bitter, California Institute of Technology, photographed invisible molecules. When he admitted gas from the pump A into the vacuum tube B, he obtained the remarkable photograph at the right. The bright rings are clusters of molecules that were formed in the gas by the passage of an electric current from spark coil C.

INVISIBLE MOLECULES CAUGHT BY CAMERA

TAKING pictures of molecules of gas, particles so small that the most powerful microscope in the world cannot detect them, was the recent feat of Dr. Francis Bitter, of the California Institute of Technology.

With these photographs he was able to count the number of molecules in a long glass tube exhausted of air but containing a little gas, and to see now their presence affected the passage of electricity.

Into the hollow tube, which had been pumped out almost to a perfect vacuum, Doctor Bitter admitted a minute quantity of gas. Then he shot an electric current through the tube, bathing it in a ghostly, shimmering radiance.

Applying a strong light at one spot on the tube's side, Doctor Bitter set up a microscope and camera at the other side. Meanwhile molecules of gas, clustering in ring-shaped groups, became visible under the passage of the electric current, as shown in the small photograph.

Although molecules are ordinarily invisible, they are plentiful. A cubic inch of ordinary air contains 400,000,000,000,000,000,000 of them.

LIGHT RAY GIVES RACER'S EXACT TIME

WHEN a Haverford College professor of astronomy suggested to his class, not long ago, that a photo-electric cell or "electric eye" might be used to time races, two of his students put the idea into use. Recently Edwin A. Speakman and Charles M. Henry completed an ingenious clocking device for sprinters that measures the runner's time with an accuracy of one hundredth of a second. In it, a beam of light from an automobile headlamp replaces the tape at the finish line.

A moving strip of paper within the device records the progress of the race. When the pistol is fired that starts the sprinter, a microphone picks up the sound of the report. Its electric impulse makes an ink mark on the tape and starts it moving. While the sprint is on, a tuning fork marks thirty-five wavy lines on the tape every second, to give a permanent record of the time elapsed. At the finish, the runner intercepts the beam of light trained on a photo-electric cell. The cell records the interruption.

MEXICANS BUILD 35-MILE ROAD IN DAY

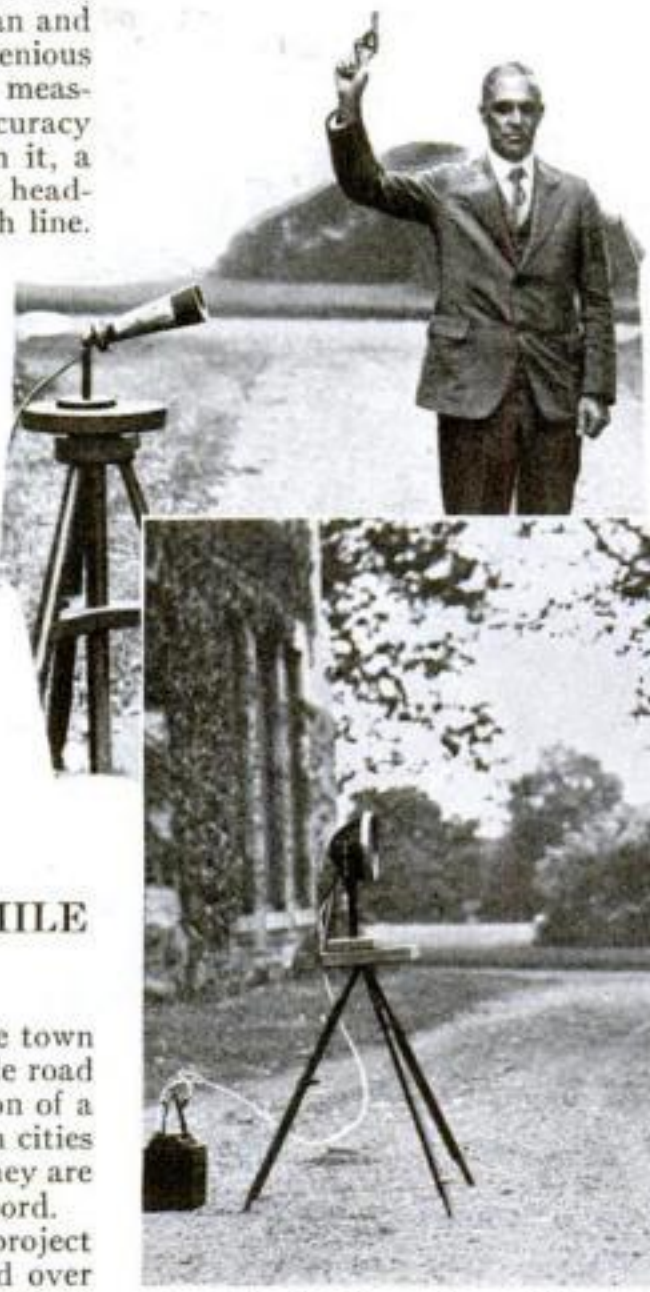
MEXICANS living in and near the town of Tremendo built a thirty-five-mile road in one day. In finishing this section of a highway that will link the Mexican cities of Guadalajara and Mexico City, they are believed to have set a world record.

When news of the intended project reached the town, messengers sped over the surrounding country. In answer to their call, 2,000 ranchers and native Taracan Indians dropped their own work and hastened to the site of the proposed road. Starting at dawn, they completed the thirty-five-mile road before the sun set.

AMPLIFIER CATCHES ROAR OF ANT HILL

AN ATTEMPT to gage the noise in the streets of an ant hill is being made by Raymond L. Ditmars of the New York Zoological Park. By introducing a test apparatus into an ant hill, he records the sounds in the ant world. When a wall of earth caves in how loud does it sound?

Amplifying devices which raise the ant noises to an intensity that is proportionate to human ears make it possible for a "talkie" of the ants' life to be made.

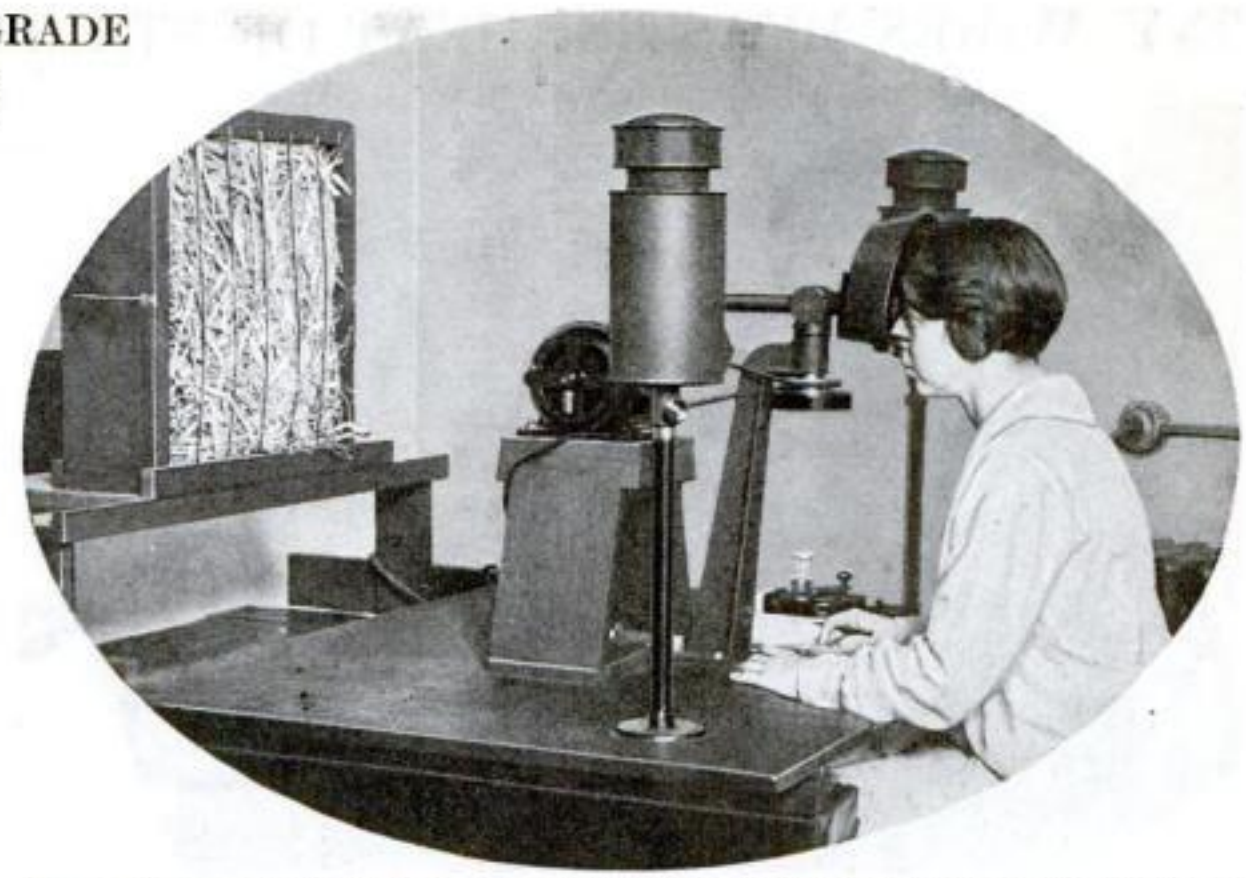


Dr. Frederick Palmer, above, of Haverford College, fires starting gun. Microphone at his left picks up report and records it on tape. Runner crossing light beam makes another mark. The two give time.

WHIRLING LENS USED TO GRADE FARM PRODUCTS BY COLOR

STANDARD grading of farm products by color is made possible by a machine developed by the United States Department of Agriculture.

Apples which are to be graded, for example, are placed in a stationary case. The observer then studies them through an eyepiece behind which a lens revolves at high speed. He sees a blurred image of the whole case, in which the red and green of the apples blend into a solid color. The hue is then compared with standard colors, which determine the grade under which the commodity is marketed. Hay and other products are similarly tested.

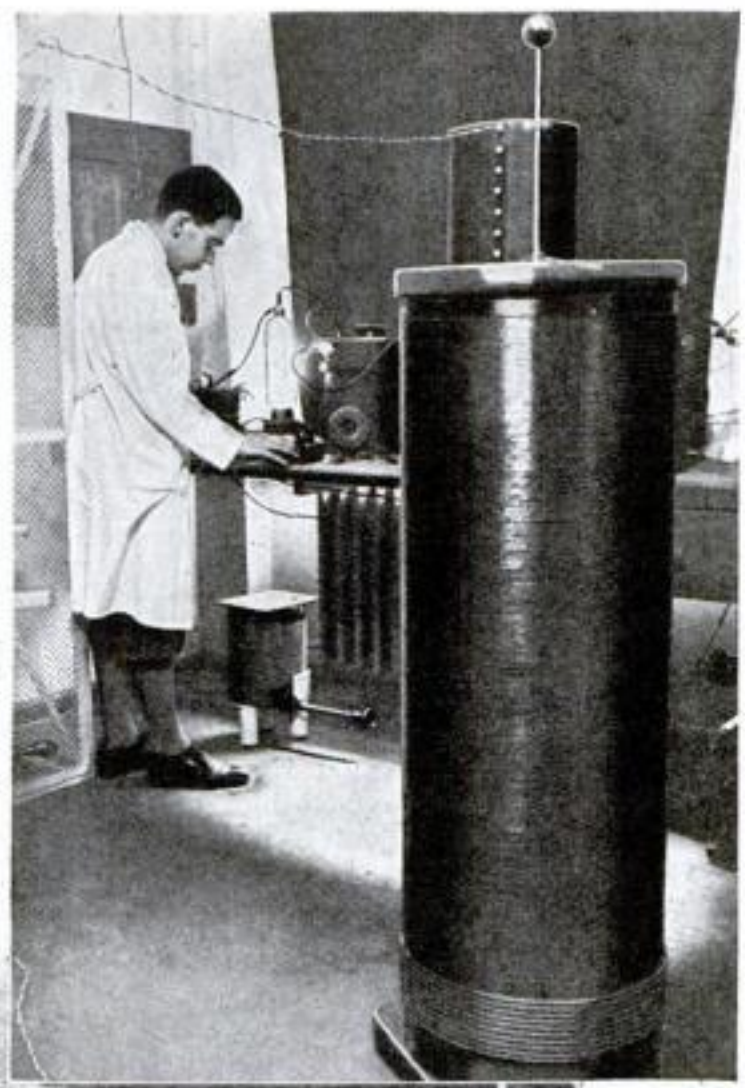


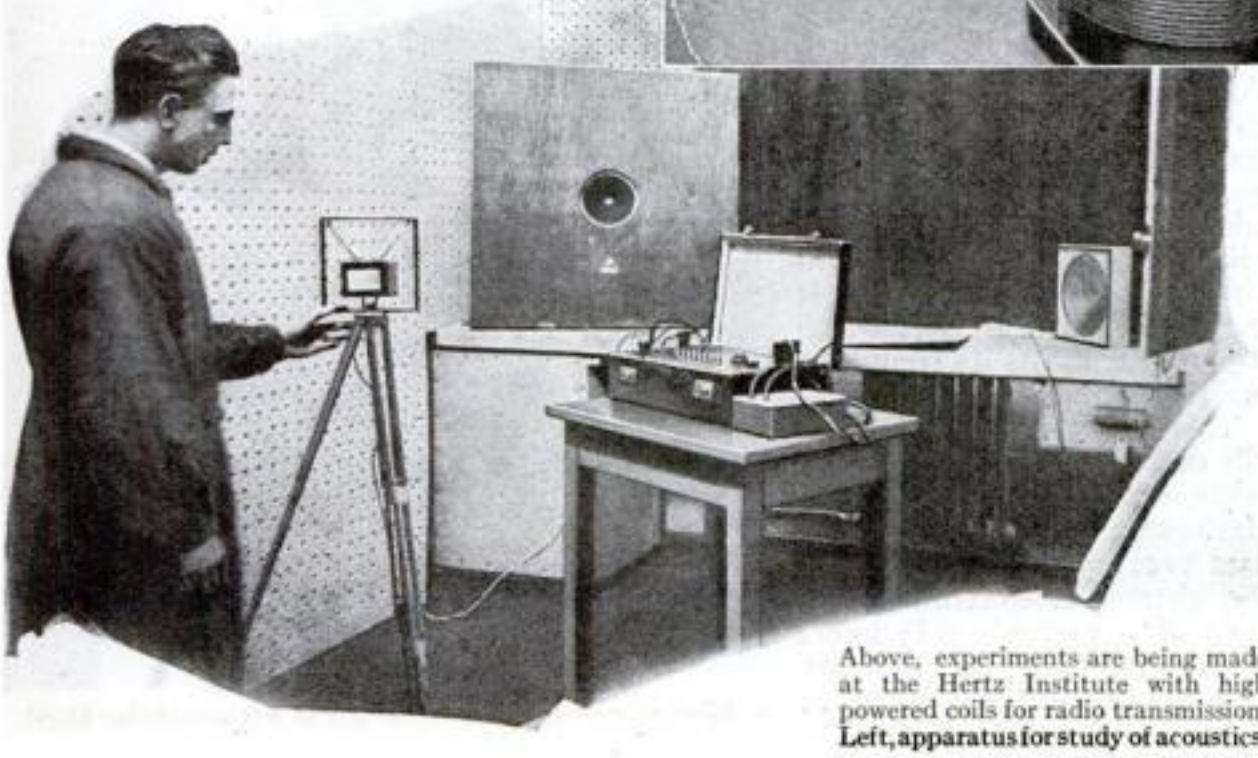
Farm products are studied through a lens that revolves at such a high speed that colors run together, making it possible to grade them accurately. The Department of Agriculture developed the device.

HERTZ INSTITUTE WILL SEEK RADIO SECRETS

UP-TO-DATE apparatus and the most advanced scientific equipment are expected to make the new Heinrich Hertz Radio Institute in Berlin, Germany, one of the most modern and productive electrical laboratories in the world. The Institute was named after the German discoverer of electromagnetic waves, whose work, toward the end of the nineteenth century, opened the way for the development of wireless and radio.

Practically every phase of radio research will be studied at the Hertz Institute. Experiments with high-powered coils for use in radio transmission and with short wave equipment are now in progress. Television is being intensively considered and new methods are being studied. Investigation of acoustic aids and appliances is being carried on. Constant attention is being given the vibration of the earth, and it is expected that this research will yield many facts.





Above, experiments are being made at the Hertz Institute with high powered coils for radio transmission. Left, apparatus for study of acoustics.

TWO-MILE BRIDGE NOW SPANS MISSISSIPPI

RECENTLY opened to traffic, the new motor and railroad bridge at Vicksburg, Miss., is the first to span the Mississippi River between Memphis and the Gulf of Mexico.

The new structure crosses the stream at a point where it is three quarters of a mile wide. More than a hundred feet above low water, Illinois Central trains cross on its single track. An eighteen-foot concrete highway alongside the track takes care of motor traffic.

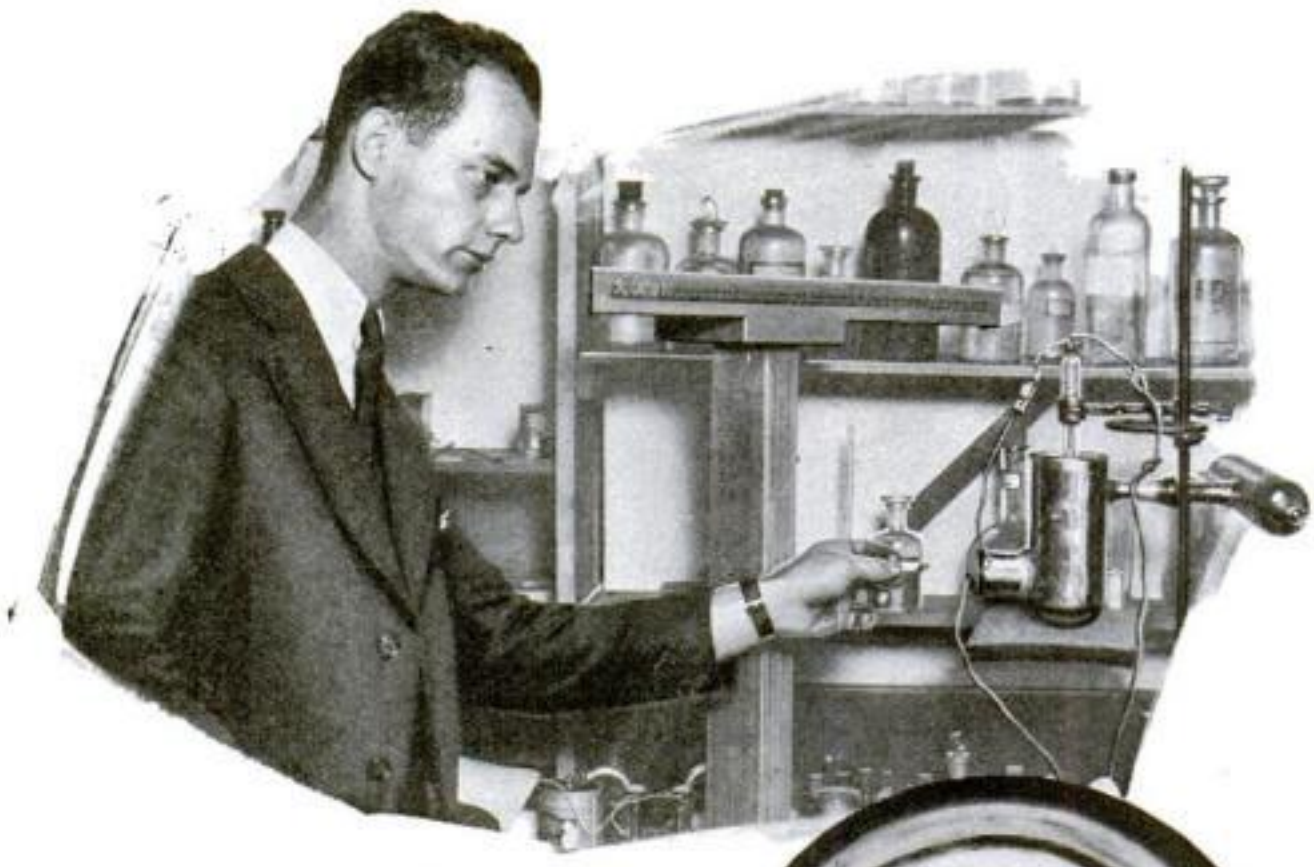
It is proposed to throw four more bridges across the lower Mississippi—two at New Orleans, La., another at Baton Rouge, La., and the fourth at Natchez, Miss.

VACCINE MAY END COMMON COLDS

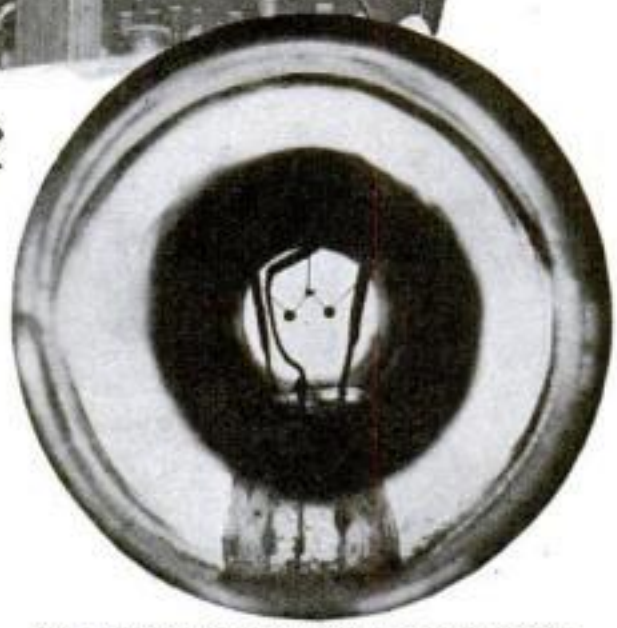
A WAY to end common colds, which cost Americans $2,000,000,000 a year in lost wages and untold misery besides, is the promise held out by Dr. J. A. Pfeiffer, University of Maryland pathologist. He has devised a vaccine which his own experiments indicate should give a person immunity against colds for from one to three years. Other experimenters, of course, must confirm his findings for them to be accepted by the medical world.

The treatment is aimed specifically against a newly-discovered germ which Doctor Pfeiffer says that he has identified as the cause of most common colds. The germ, which has been named "micrococcus coryza," is entirely new to bacteriology. Doctor Pfeiffer is reported to have isolated it after seven years of research. He has tested it as the cause of colds by inoculating volunteers with the germs. They developed the usual "sniffles," accompanied by sore throats. Doctor Pfeiffer's work was made easier for him by the fact that few persons were afraid to contract a mere cold.

TINY WIRES MEASURE HEAT OF STARS



A glowing cigarette tip is like a blast furnace to this device that measures the heat of distant stars.



Close-up of two wire joints and gold leaf in instrument affected by least temperature rise.

JOINTED pairs of wires, so tiny that it would take a thousand of them to equal the weight of a drop of water, measure a star's heat in a new super-sensitive instrument developed by C. Hawley Cartwright, twenty-five-year-old research fellow of the California Institute of Technology. The instrument can gage differences in temperature of less than a millionth of a degree.

The warmth of a finger tip swings the recording needle of this delicate device, and a glowing cigarette tip affects it much as a blast furnace would affect an ordinary thermometer. It is being used at Mt. Wilson Observatory, Calif., to measure the energy received from nebulae hundreds of light-years away.

Instruments of this type, known as "thermocouples," gage temperature by measuring the electric current that is generated when a jointed pair of wires, of different metals, are warmed. In the new instrument, a star's light and heat rays are concentrated by a telescope upon a piece of gold leaf so thin that it is transparent, which absorbs the heat and transfers it to the delicate joint of wires. The current generated is then recorded on a sensitive meter. The instrument houses a pair of the joints in a vacuum chamber.

USE FRINGES OF LIGHT TO GAGE PLANT GROWTH

A NEW instrument, similar to that used to measure the diameters of stars, enables one to watch a plant grow.

Prof. K. W. Meissner, of Frankfort, Germany, adapted to this purpose the astronomical "interferometer" developed by Prof. A. A. Michelson, of the University of Chicago. It uses fringes of light to check very small distances. With his modified instrument, Professor Meissner observed plants and announced that most of them gained in stature an average of 1/100,000th of an inch a second.

NO ODOR FOUND THAT STOPS MOSQUITOES

CARBON dioxide from the human breath is the perfume that is irresistible to mosquitoes, drawing them like a magnet to human beings whom they consequently bite. This is the finding of Dr. Willem Rudolfs, of New Jersey, after long and painful experiments with the insect pests.

Doctor Rudolfs and his wife made martyrs of themselves for science, visiting, day after day, in rain and sunshine, the Jersey swamps. There they deliberately subjected themselves to mosquitoes until their arms were red with bites. They tested the effect of citronella, pyrethrum, oil of wintergreen, and a large number of other substances in driving off the mosquito squadrons.

Etherial camphor proved to be one of the strongest protections, for the mosquito, "when coming into contact with the odor of this powerful repellent," according to Doctor Rudolfs, "attempted to escape so quickly and moved its legs so convulsively that the members were frequently torn from the body."

From even this gas attack, however, the mosquitoes were frightened away only temporarily, for the protecting odors of all the substances tried gave immunity for only two hours at the most. Hence Doctor Rudolfs admitted that no true repellent has as yet been discovered. Destroying mosquitoes in the larval stage, when the wormlike young of the insect is breeding in pools, or destroying the plant food upon which the larvae feed, is considered by Doctor Rudolfs to be the most practical way of attack. He holds hope for the future. "In a hundred years or so it is by no means improbable that we will be rid in suburbs and towns of this vicious and relentless pest."

MACHINE TRAPS LIAR BY HEARTBEAT

WHETHER a machine called a "lie detector" can trap a lying criminal and convict him in a court of law is soon to be determined at the University of Chicago. The work will be directed by Prof. August Vollmer, who left his post of Chief of Police of Berkeley, Calif., to become professor of criminology.

While a police head, Professor Vollmer developed the remarkable device. A criminal, he says, may glibly deny guilt, but the machine, which records his telltale heartbeat and respiration, will give him away, when a word associated with the crime is mentioned. The device, which is portable, draws its records in pen lines on a moving chart.

This is not the only type of "lie detector" in existence. Another, developed by Dr. S. R. Hathaway, of Ohio University, uses vacuum tubes to measure the change in electrical resistance of a person's skin under questioning (P. S. M., Dec. '29, p. 149). It is being tried at the University of Minnesota.

Band around the arm of the girl at left reveals her blood pressure changes on a moving chart when a falsehood is told.

RAILWAY DINING CAR REAL REFRIGERATOR

AMERICA'S first refrigerated railway car for passengers was put in service recently on an express train running between Washington, D. C., and New York City. In the dining car *Martha Washington*, passengers enjoy a temperature ten to fifteen degrees cooler than that outside.

The *Martha Washington's* equipment cleans the outside air of soot and cinders, passes it through cooling coils filled with ammonia, similar to those of large commercial refrigerators, and then distributes it through the car by heat-insulated ducts. Mechanical refrigeration makes this system different from that of an ice-cooled French railway car recently tried out (P. S. M., Apr. '30, p. 46).

NEW PROCESS EXTRACTS RADIUM IN ONE MONTH

RADIUM extraction in a period of thirty days is possible, according to statements of a Pacific Coast mining company, with a process developed by Arthur A. Burton, mining chemist. Heretofore this work required six months. It is expected that the new method will make possible large scale production and a lower price.

All radium now mined comes from the Belgian Congo, where a gram (1/454th of a pound) of the precious substance is extracted from 500 tons of rock. In doing this 500 tons of chemicals, 1,000 tons of coal, 10,000 tons of distilled water, and the labor of 150 men for a month are necessary. Extracting the pure radium requires five weeks' work by a corps of expert chemists, and four more months elapse before the gram is ready for use.

WOOD BLOCK TESTS OILINESS OF OIL

A crank raises the tilting block in this apparatus which is used to determine relative oiliness of various grades of lubricants

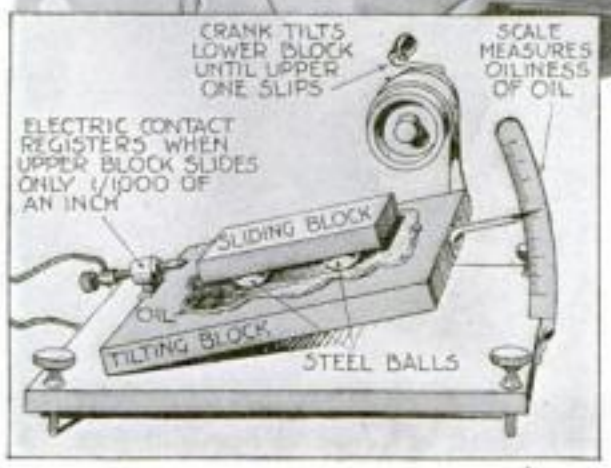


Diagram shows how the slipperiness of oil is registered on a graduated gage and by electric contact as end of block is raised by the crank.

SLIPPERINESS of oil is now determined by an ingenious measuring device employed in the research laboratories of the Westinghouse Electric and Manufacturing Company. The angle at which a small wooden block mounted on steel balls over a polished steel plate (coated with oil) must be pitched in order to start sliding measures the lubricating quality of the oil being tested.

A movement of only 1/1,000th of an inch of the platform is recorded by a voltmeter (an instrument for gaging electrical pressure), which is deflected as the platform touches a certain needle, making a circuit. The smaller the angle at which the wooden block slips, the more "oily" is the oil being examined and the better it is for lubricating purposes.

RATS FIND VITAMIN-G IN COTTONSEED

Rat, fed on cottonseed, is weighed by Dr. Henry Stevens, Department of Agriculture, who found vitamin G in meal.

COTTONSEED meal, commonly used for cattle food, may yet become an important article of human diet. After feeding it to white rats, Dr. Henry Stevens, of the United States Department of Agriculture, reports that it is the cheapest source of vitamin-G, which cures and prevents pellagra. This disease, most prevalent in the South, is caused by malnutrition or a diet deficient in vitamin-G.

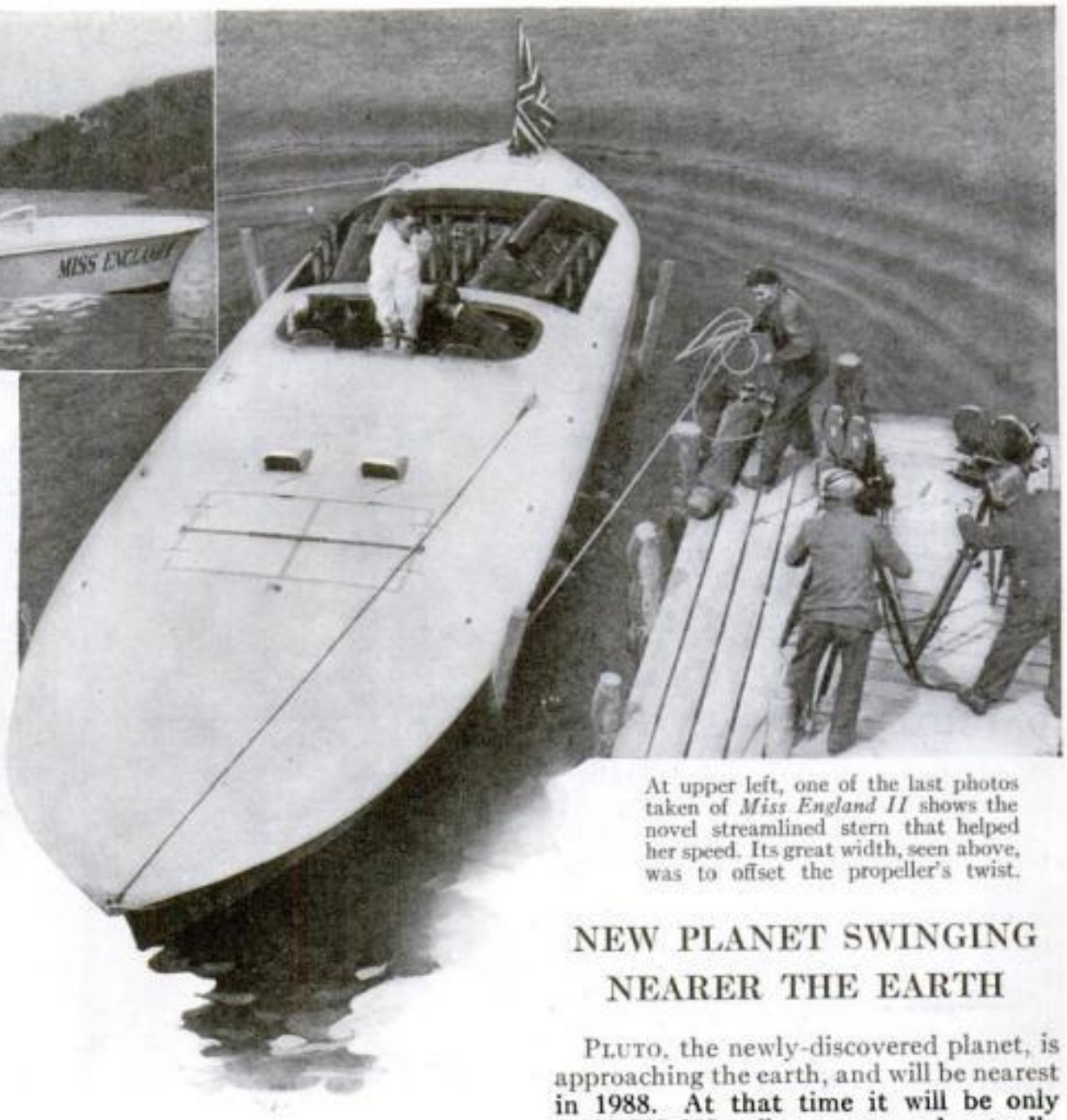
Many foods are known to contain the healthful substance, among them lean meat, fish, eggs, milk, and yeast. The last-named is the richest-known natural source. Now cottonseed meal turns out to be nearly as rich as yeast in vitamin-G, and far lower in cost.

Vitamins are elusive substances, never definitely isolated to date. But although a chemist cannot find them in foods, their presence or absence can be revealed by feeding the diet to white rats bred especially for the purpose, and noting whether the rats thrive or languish.

GIGANTIC SUGAR CANE GROWN IN FLORIDA

SUGAR cane as tall as a bungalow is growing in Florida, where a new type with stalks twenty-five to thirty feet high is being given its first try-out in America. This monster variety was imported from New Guinea, in the East Indies, its native home (P. S. M., Feb. '29, p. 52).

Vigorous growth and resistance to plant disease mark this cane, which it is planned to cross with the sugar cane grown in this country. The process of importing the new variety took over a year, for it had to be transported a short distance at a time to accustom it to the change in climate. Traveling by way of Australia, where it made a temporary stop-over, the plants which took the slow journey lived while few of those imported direct survived. Much the same experience was had in Honolulu, where an insect enemy of a sugar cane parasite was imported from the East Indies. The insect friend was brought first to Australia and then gradually to Hawaii.



At upper left, one of the last photos taken of *Miss England II* shows the novel streamlined stern that helped her speed. Its great width, seen above, was to offset the propeller's twist.

WHY SEGRAVE'S RACER SET NEW SPEED MARK

MAJOR SIR HENRY SEGRAVE, British speed king, achieved his ambition of giving the world's speed boat record to England just before the accident that ended his life. His amazing motor boat, *Miss England II*, roared over the water of Lake Windermere, England, at the terrific pace of more than 100 miles an hour, in one of the two laps that were averaged to give his official record of 98.76 miles an hour. It was while Segrave was attempting to better this record in a third try that the boat, traveling at a hundred-mile clip, apparently hit a half-submerged log and, with a hole in her hull, dove under the water, killing Segrave and one of the two mechanics who rode with him.

The new speed record was officially confirmed by the International Motor and Yachting Union. It remains unofficial here, because American rules require a six-lap average.

Extraordinary design enabled the thirty-eight-foot boat to break the ninety-three-mile-an-hour record of Gar Wood, American sportsman. Four thousand horsepower, the combined output of two enormous engines patterned after racing airplane motors, drove a sihgle propeller at the almost incredible speed of 12,000 revolutions every minute—200 a second! Lest the reaction of this spinning propeller against the water tilt the boat sideways and upset it, the boat was given the unusual width of ten and one half feet. A curious streamlined, wedge-shaped stern reduced wind resistance above water to a minimum. In power and design the craft was a fit mate for the car known as the *Golden Arrow*, which Segrave drove last year to a world's record of 231 miles an hour at Daytona Beach, Fla. (P. S. M., June '29, p. 46).

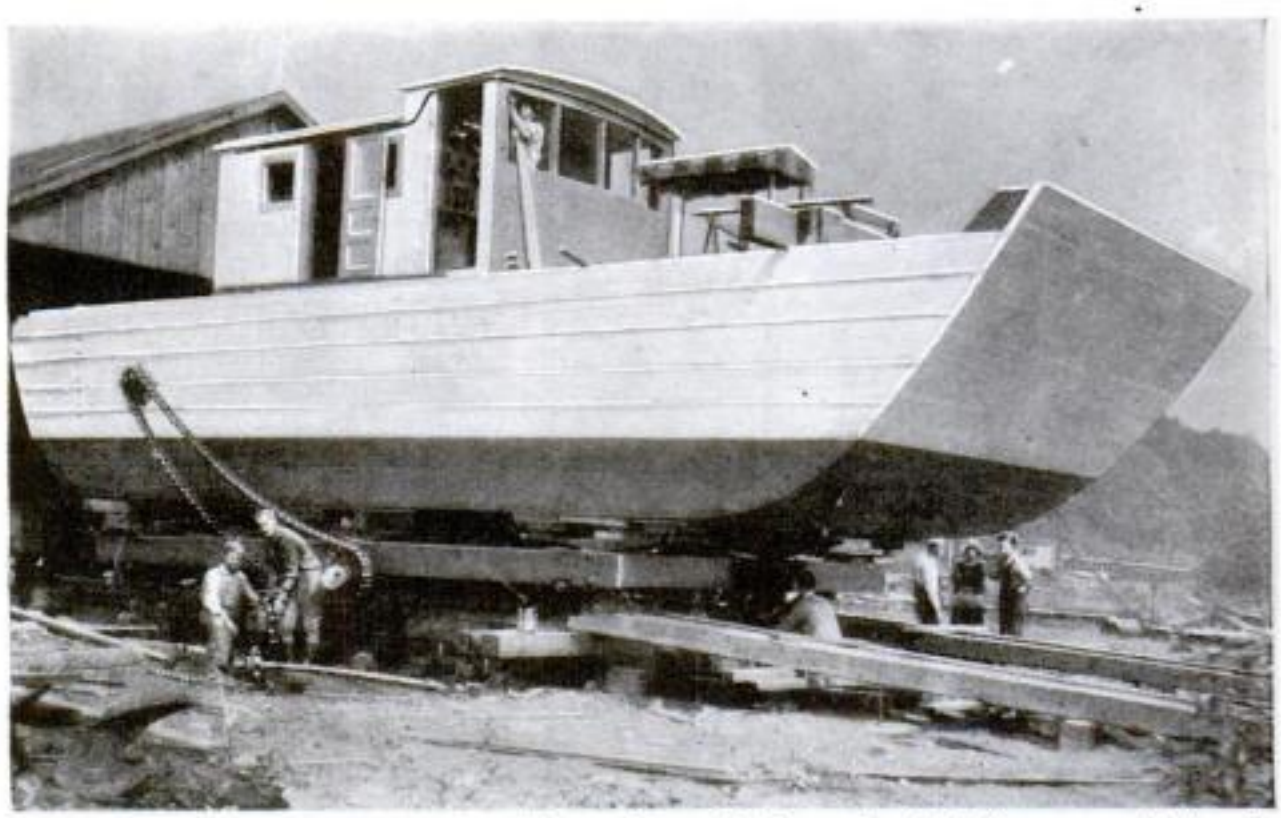
NEW PLANET SWINGING NEARER THE EARTH

PLUTO, the newly-discovered planet, is approaching the earth, and will be nearest in 1988. At that time it will be only 2,800,000,000 miles away, and actually within the orbit of the normally nearer planet Neptune. This is made possible by its unusually elliptical path around the sun, which has just been computed at Mt. Wilson Observatory in California.

When Pluto was first discovered (P. S. M., June '30, p. 27), it was feared that many years would be required to map its course around the sun. However, eleven-year-old photographs unearthed at Mt. Wilson show enough of Pluto's path to plot the rest. Pluto takes 251.8 years to circle the sun.

BOAT WITH GLASS BOTTOM CAN CRAWL

FITTED with a glass bottom for the study of the sea floor, a scientific ark will soon take to the shallow Pacific waters along the Oregon shore. Running aground has no terrors for this strange craft, for it can crawl along the bottom propelled by four caterpillar treads like those of a tractor. Its speed is fifty feet a minute. The boat is the invention of G. F. McGowan, of Portland, Ore. It is forty-two feet long, and is powered with a seventy-five-horsepower gasoline motor.

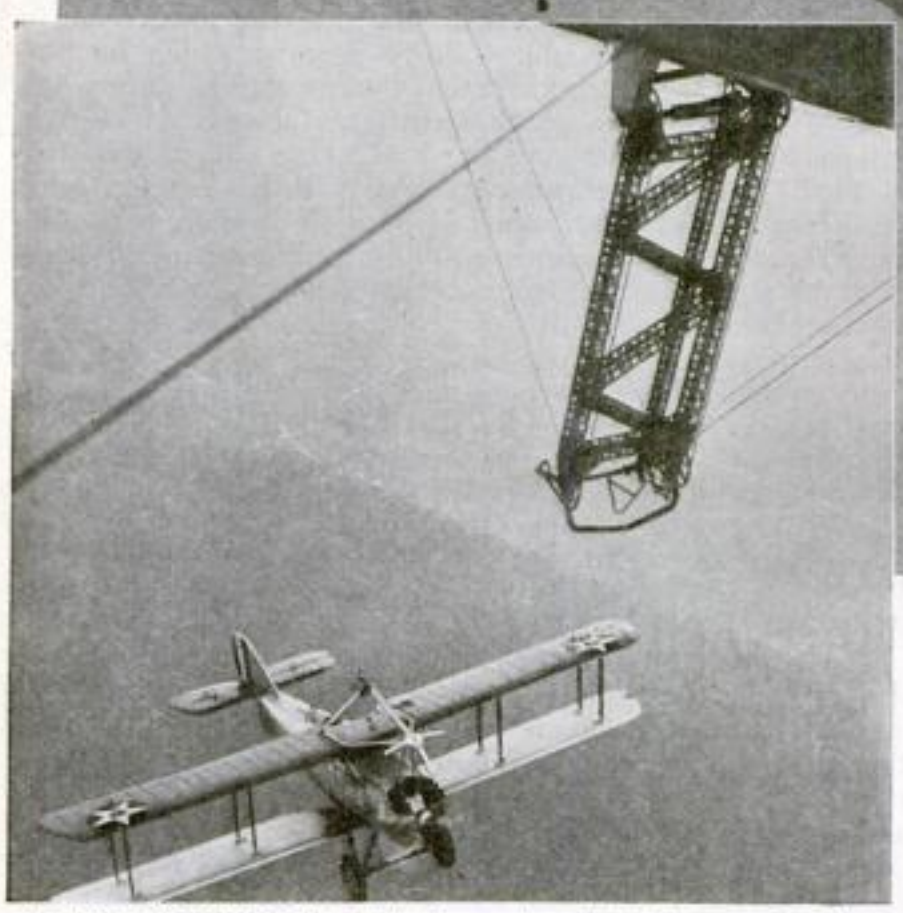


This scientific ark, with glass bottom, will be used to study the sea floor in shallow water. Equipped with four caterpillar treads, it can crawl along the sand of beach or sea bottom at 50 feet a minute.

WATCH YOUR RADIO DIET

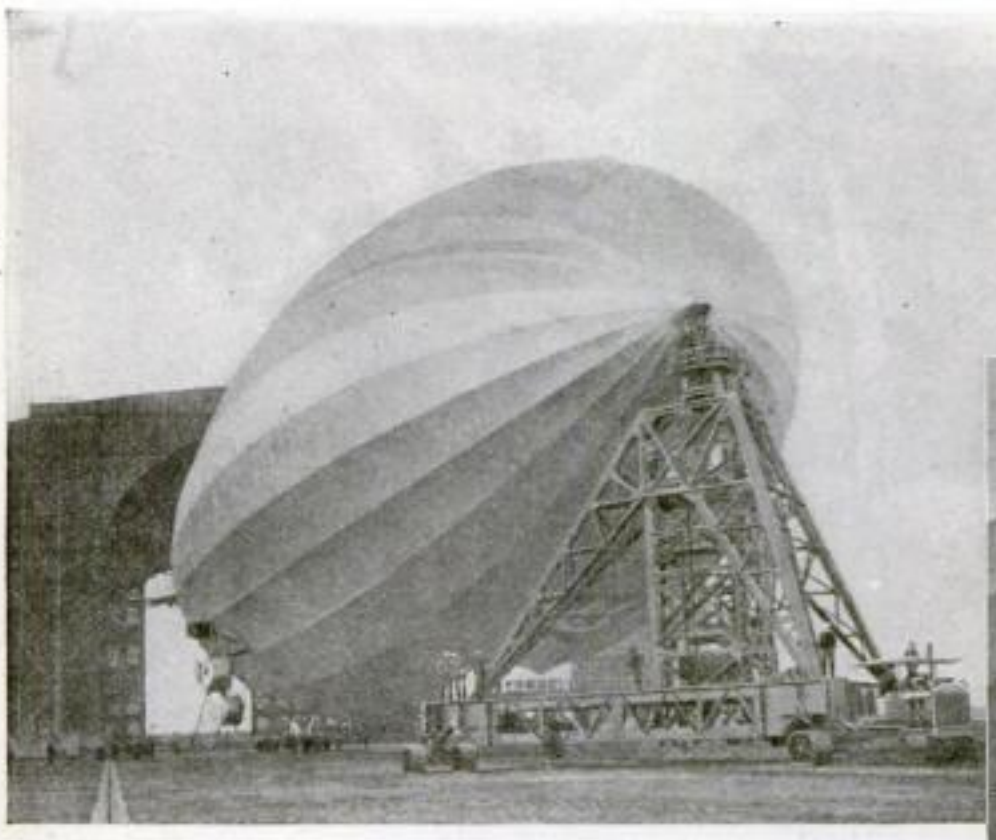
REGULATION of one's radio program diet may be a medical watchword of the future. Overuse of the radio may lead to mental indigestion just as overeating brings on physical indigestion, according to Dr. R. Sommer, of the University of Giessen, Germany. The radio rightly used, he said, might help mental hygiene.

Big Changes Give Giants of the Air Far Wider Range



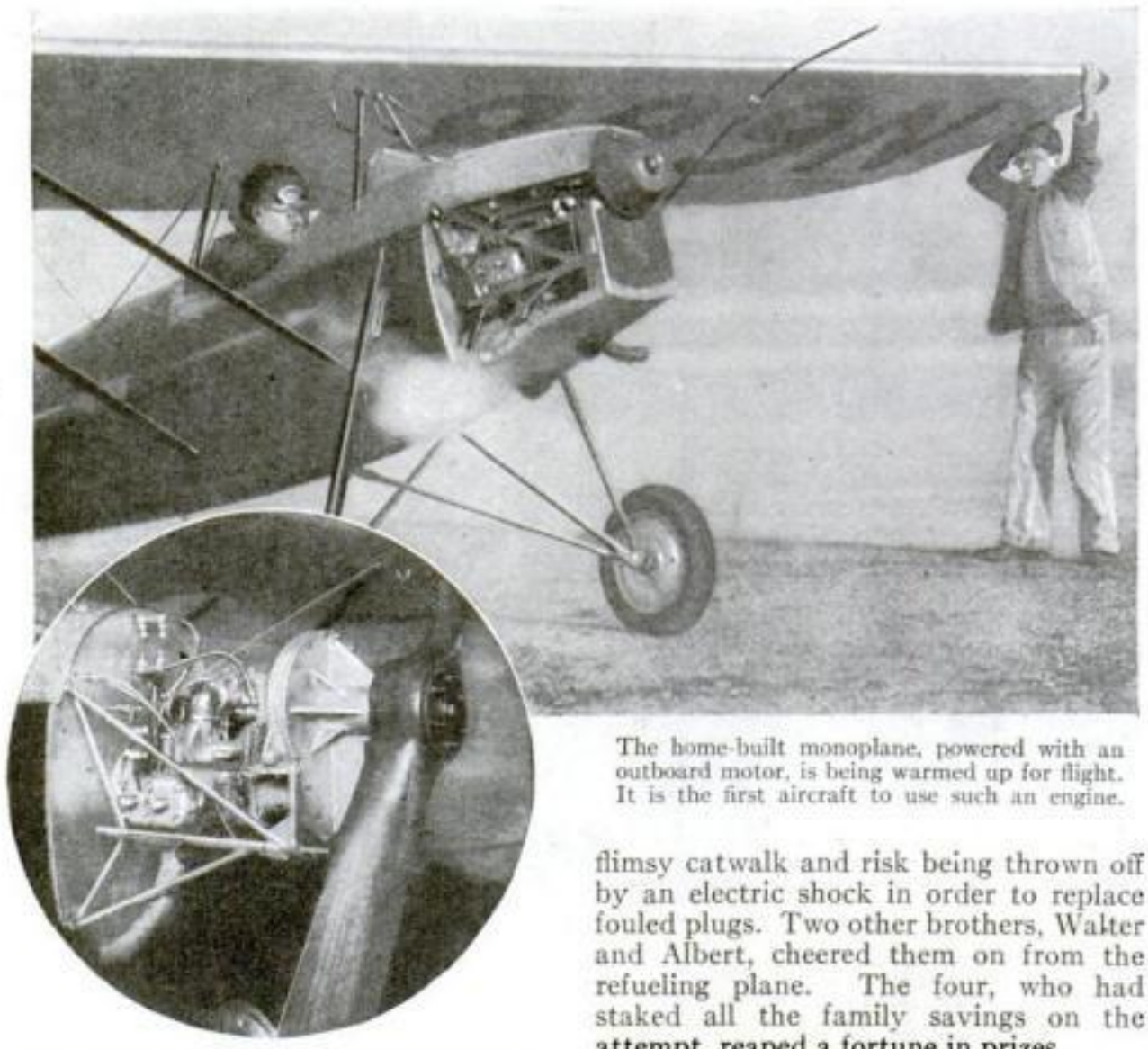
READY TO HOOK ON. This Navy plane is darting up under the *Los Angeles* and will snap onto the framework suspended from it.

PLANES LAUNCHED BY DIRIGIBLE. The striking picture at the top shows a Navy plane roaring up beneath the enormous *Los Angeles* the instant before it engages the bar by which it is carried and from which it can be whirled into space. In the circle is a clear view of the mechanism taken at the instant of contact. A hook on the upper wing of the plane fastens over the mooring bar attached by a folding steel framework to the bottom of the airship. This device widens the cruising range of dirigibles.



LAND TUGBOATS FOR AIRSHIPS. In July last year POPULAR SCIENCE MONTHLY published a drawing and description of the movable mast for dirigibles, but here for the first time is a photograph of the remarkable machine. The mast, powered by a tractor, does the work of 200 men in getting the airship into and out of its hangar. At right, a close-up of the mast.

OUTBOARD MOTOR POWERS AIRPLANE



The home-built monoplane, powered with an outboard motor, is being warmed up for flight. It is the first aircraft to use such an engine.

Close-up of the 100-pound motor that drives this plane, showing speed reducing sprockets.

ALTHOUGH airplanes often have been flown with motorcycle and automobile engines, it remained for two University of Washington students to equip a plane with a standard outboard motor exactly like those used on water craft. Their midget plane recently flew successfully at Tacoma, Wash.

The students, Robert Davis and Gernot Heinemann, spent six months building a mosquito-sized monoplane with twenty-five-foot wing spread. Then they installed the four-cylinder, thirty-two-horsepower outboard motor, which weighs only 100 pounds. This motor has a maximum speed of 5,000 revolutions a minute, and to gear it down to the proper propeller speed of 1,500 revolutions per minute the students substituted a small sprocket for the water propeller. A chain drive connected this with a larger sprocket on the propeller shaft, the difference in the size of the sprockets reducing the speed. This is said to be the first reduction gear to be used in an airplane.

NEW SPARK PLUGS HELP ENDURANCE FLIGHT

IT'S a tense moment in a record endurance flight when the engine needs new spark plugs. This remarkable photograph, snapped from another plane, shows one of the perilous feats that Kenneth and John Hunter performed to keep their blue-and-orange monoplane, *City of Chicago*, aloft for 553 hours, breaking the former eighteen-day world's refueling mark.

Thousands of feet above the ground, it was necessary to crawl forward along a flimsy catwalk and risk being thrown off by an electric shock in order to replace fouled plugs. Two other brothers, Walter and Albert, cheered them on from the refueling plane. The four, who had staked all the family savings on the attempt, reaped a fortune in prizes.

GLIDER AND PILOT MUST GET LICENSE HEREAFTER

GLIDER pilots are to be licensed, as well as airplane pilots, according to a recent announcement of the Department of Commerce's Aeronautics Branch. There will be three classes. A "student" license permits the holder to fly under the instruction of a licensed pilot. With a "noncommercial" license he can fly alone for sport and pleasure. Others must have a "commercial" license. The last requires an elaborate demonstration of gliding skill, and a physical examination.

Gliding craft, too, are now to be licensed, and homemade craft must be built to Federal specifications from approved plans. The new rules are intended to safeguard gliding.

DEATH PLAYS TAG WITH AIRMEN—AND LOSES

STRANGER than fiction were some of the events that happened recently in the world of aviation. In one a plane became a deadly merry-go-round, in another an observer hung from a runaway balloon, and in a third a pilot won a prize he didn't want.

C. C. Curry was flying away from a Delano, Calif., vineyard which he had sprinkled from the air with sulphur when his plane struck and broke an electric transmission line. One end of the wire became entangled with his landing gear. Curry found himself tethered to the transmission tower, flying around it in narrowing circles as the wire wound up. Hastily he landed his plane and thus escaped death.

An observation balloon in Wales with two men aboard snapped its cable while being hauled to earth. One of the observers leaped to safety. The other, Flying Officer Pelham Groom of the Royal Air Force, tried to jump but caught his legs in the rigging. Hanging head downward, he was carried two miles with the ground men in pursuit. Finally they overtook the balloon and saved Groom.

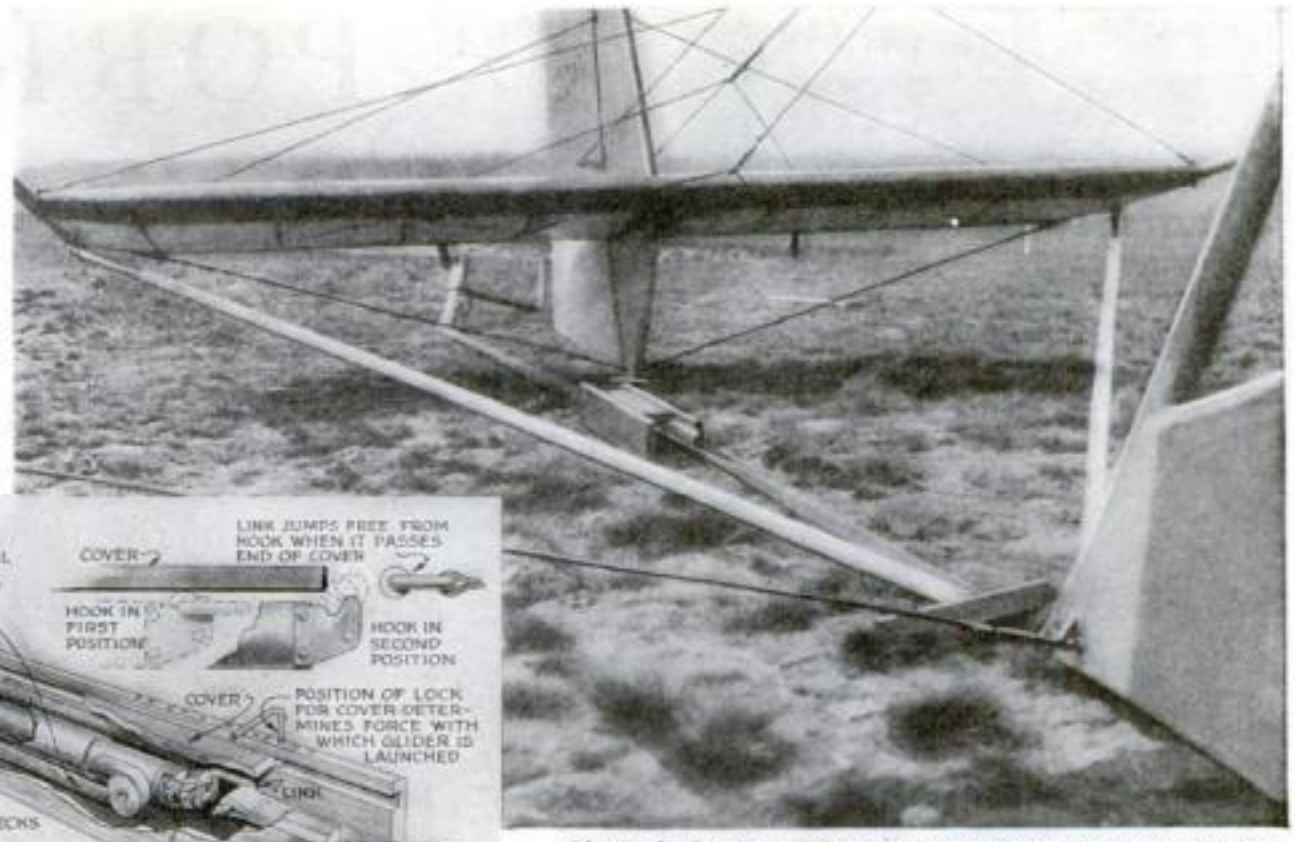
A student at the Boeing School of Aeronautics, Oakland, Calif., won as a prize for a certain type of flying a small bronze jackass with wings. To win it, the student had gone out on a flight at night without turning on his navigation lights.

Thousands of feet in the air new spark plugs were needed if the *City of Chicago* was to set new refueling record. So one of the Hunter brothers, defying death, changed them.

GLIDER SHOT INTO AIR BY LAUNCHING MACHINE

LEST the half dozen young men on the end of a rubber launching cord should catapult a novice glider pilot into the air too vigorously for his own good, a new automatic release starts the glider on its way at just the right speed.

No men are needed to hold back a glider until it is ready for launching, with this device, which was invented by Heinrich Knott, German instructor of the American Motorless Aviation Corporation's gliding school at Cape Cod, Mass. It holds the tail of the glider to a stake firmly fixed in the ground. For launching, the ground crew attach a long rubber "shock cord" to the glider in the usual way, and then start pulling. As soon as their combined strength has reached a certain predetermined force, the release box lets go of the tail and the glider shoots into the air.

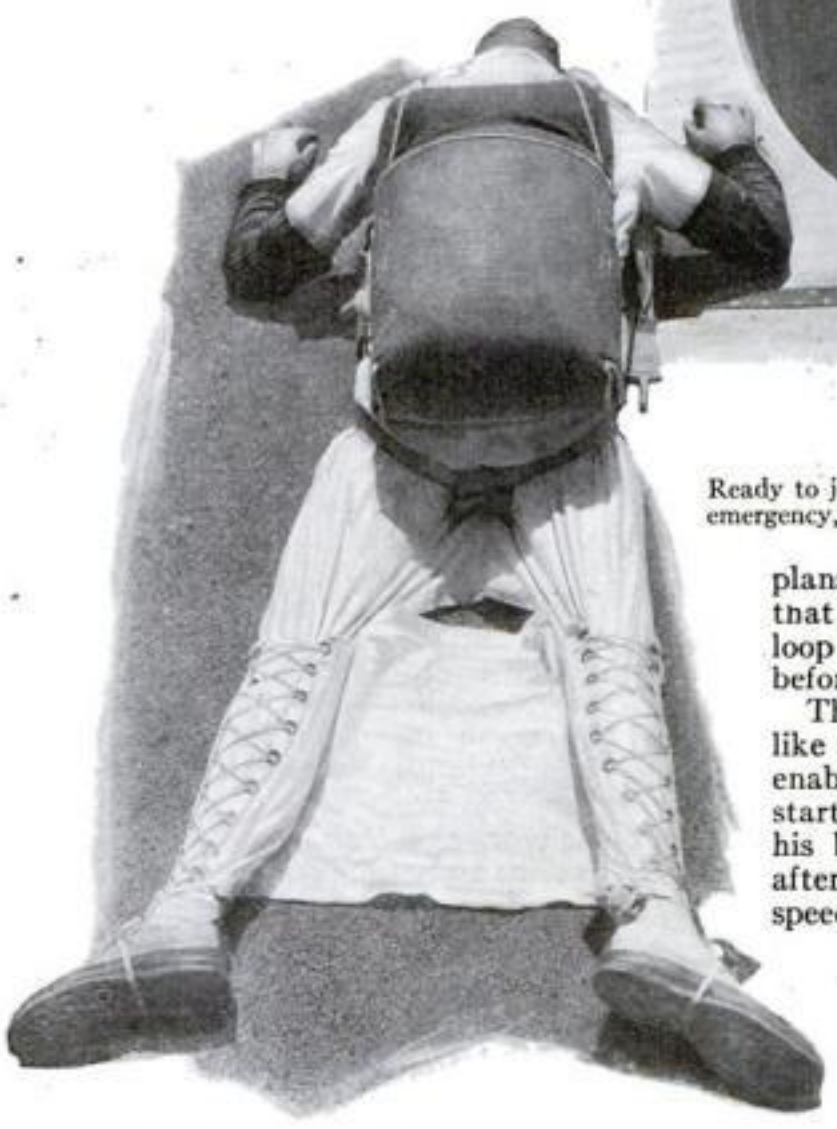


Above, looking past the tail of the glider at the automatic release box. At left, diagram of launching device shows how the plane is permitted to jump free when the pull by the ground crew on the shock cord reaches a certain force.

HUMAN FLYING SQUIRREL ZOOMS THROUGH AIR

DIVING through the air in any direction, like a flying squirrel, is a new pastime for aerial dare-devils. The idea was conceived by Rex G. Finney, of Los Angeles, who recently demonstrated a "tail fin," a strip of canvas stitched between the legs, by which a falling person can steer himself in the air. With this device and similar armpit-fins, which Finney plans to add, it is expected that a parachute jumper can loop the loop and do barrel rolls before opening his 'chute.

The tail fin alone, which acts like the elevator of an airplane, enables a jumper to perform startling feats. When he arches his back and flexes his knees, after acquiring enough falling speed, he actually zooms upward. The stunt has a possible practical use, according to Finney. A naturally top-heavy parachute jumper, with this device, might right himself just before opening his parachute.



With sail cloth fin between the legs a parachute jumper is able to reduce the jerk that accompanies the opening of the big 'chute.

Ready to jump. Wearing a fabric vest, the passenger, in emergency, snaps it on, jumps, and pulls the rip cord.

FOOLPROOF 'CHUTE FOR THE NOVICE

AERIAL life preservers may safeguard passengers on air transport lines, following recent tests at the Los Angeles Municipal Airport of a "foolproof," detachable parachute that does not encumber the wearer.

Passenger planes do not carry parachutes at present because passengers object to wearing so bulky an object on a long flight. Now, however, they would be required to don only a light fabric vest carrying a steel snap. In case of emergency, the passenger would grasp the 'chute itself, which hangs beside or above his seat, and clip it to his vest with a single movement. Then he would open the cabin door, step from the plane, and pull the rip cord. Experiments showed that this entire operation required but ten seconds' time.

BALLOON GUIDES FOG BOUND PILOT

BALLOONS anchored above an airport, and a trailing wire on his plane, guide a pilot to a fog-covered landing field in a system just tested in England. A Royal Air Force flyer, aided by balloon and wire, recently made five successful landings through a fog bank more than ninety feet thick.

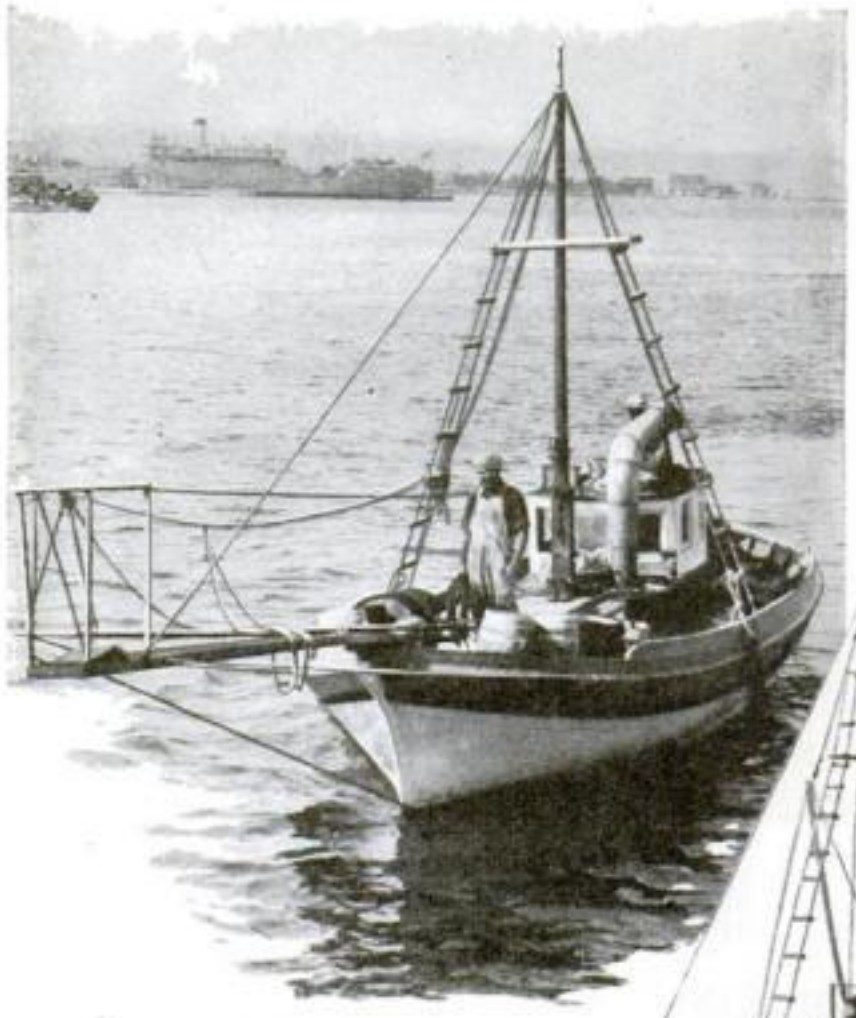
When the pilot approached the airport, he saw the balloon, which was visible above the fog.

Knowing the direction of the airport from this marker, he glided slowly downward and unreeled a weight hung on a trailing wire beneath the plane. A second later, a red light flashed on his instrument board. It showed that the weight had touched the earth. With the ground still invisible, he leveled off and made a perfect landing.

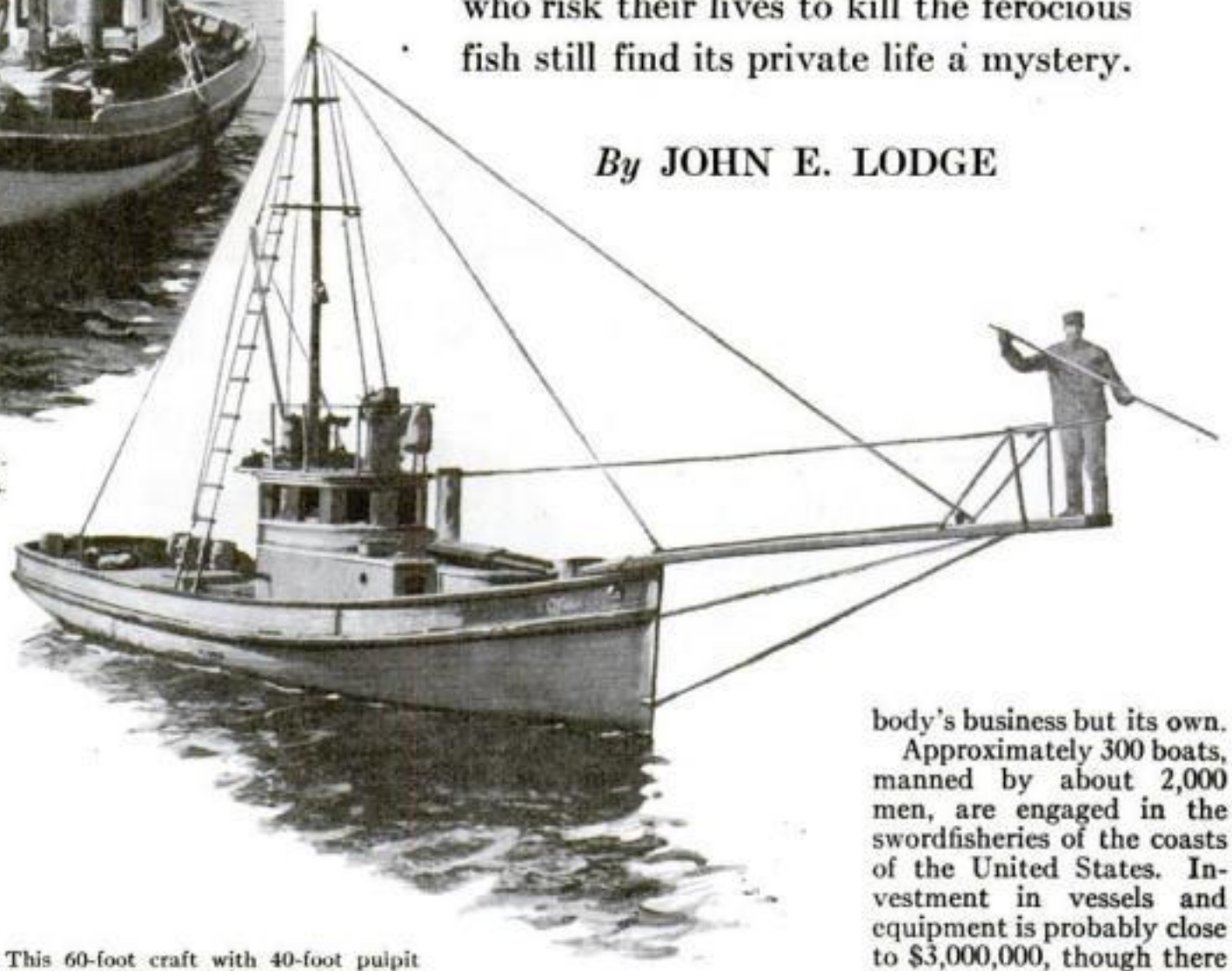
PORK CHOPS *from the* SEA

Where does the swordfish, wild hog of the oceans, make its home? Fishermen who risk their lives to kill the ferocious fish still find its private life a mystery.

By JOHN E. LODGE



A century ago, the design for this swordfish boat was imported from Corsica



This 60-foot craft with 40-foot pulpit is a typical boat of the swordfish fleet.

UP AND down both coasts of America, hundreds of men are hunting "wild hogs of the sea." In scores of comparatively small boats they bring back a new food supply similar in taste, texture, color, and nutritive value to the best of corn-fed pork. Against the eight cents a pound which the American farmer received as an average for his carefully-grown pigs in 1928, these maritime hog hunters are paid thirty cents on the Atlantic and twenty cents on the Pacific, an average of twenty-five cents. Where a 400-pound porker nets $30 to $35 to his owner, a swordfish of the same weight will put $100 or more into the pocket of the harpooner.

But this business of bringing home the bacon—or, more correctly, the pork chops—from the seas is no mere matter of hog calling. More than 300,000 pounds of swordfish meat were brought into San Diego and San Pedro, the two ports of this industry on the Pacific, in 1928. Estimates are that more than twice this quantity was delivered to Boston and other ports on the Atlantic. For every pound of this large total, a man risked his life at the end of a slender plank, pitching above a rough sea, or in a thin-skinned boat whose sides offered little obstacle to the three-foot sword of the wild pig that swims.

State and national fisheries authorities estimate that casual catches increased the total swordfish-meat production for 1928 to 1,200,000 pounds, for which the hunters received a minimum of $240,000. This is not a large aggregate, compared with $20,000,000 for sardines, $16,000,000 for tuna, or more than $50,000,000 for salmon; but pound for pound, it is the most remunerative fishing in the world.

The sardine seiner receives $100 to $120 for a ton of the tiny fish; the tuna hook-and-liner is paid $120 to $130 for 2,000 pounds of yellow-fin or blue-fin; but a ton of swordfish, delivered in any of the coastwise markets of the Atlantic or the Pacific, puts a minimum of $400 into the hands of the fortunate fisherman. Only the albacore at $220 to $250 a ton even approximates this fish in value, and the former appears to have deserted the Pacific coast of the United States.

Now that whaling has discarded the longboat and the lance in favor of the steam tug and the harpoon gun, swordfishing has become the most dangerous of all the commercial fisheries. At the same time, its success depends on the cleverness and ability of the men engaged in it. The man at the wheel must "lay" the small ship directly on the "broadbill," usually as the fish lies asleep on the surface of the sea. The harpooner, riding a bobbing plank projecting far from the bow of the boat, must know just when, where, and how to drive home his twenty-foot spear. Above all, the skipper must know exactly where to find the swordfish, a creature of the deep waters whose wanderings are nobody's business but its own.

Approximately 300 boats, manned by about 2,000 men, are engaged in the swordfisheries of the coasts of the United States. Investment in vessels and equipment is probably close to $3,000,000, though there is no exact method of checking up on this sum. Nor can the investment be charged to swordfishing alone, since more than half of this fleet engages in other fisheries during the off-season for "broadbills." The boats range from twenty-five to 120 feet in length, by eight to twenty-five feet beam, with engines of ten to 200 horsepower. On the Atlantic coast, sails are used to help out the motors; on the Pacific, engines alone are depended upon for motive power.

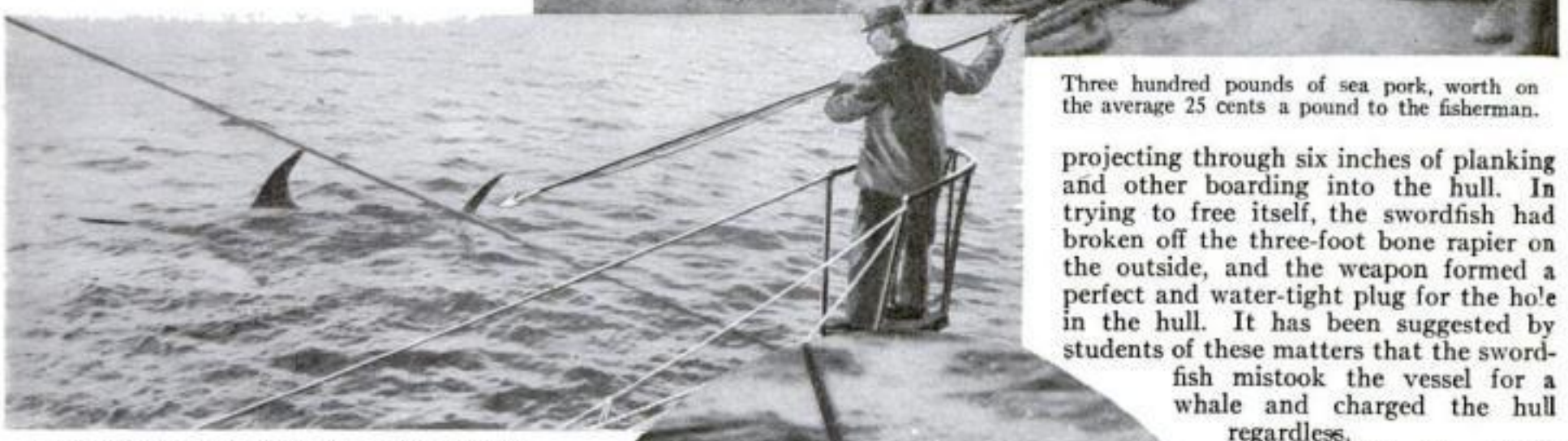
CREWS range from two or three to a dozen men. One of the most successful swordfishermen on the Pacific coast, who has been killing wild hogs of the ocean for more than forty years, operates in his own twenty-six-foot boat, of which he is owner, skipper, mate, engineer, and crew. On his voyages he remains away from port two to four days, depending on the catch, and he has killed more than 800 swordfish in his years of hunting them. One-man deep-sea fishing of any kind is exceedingly dangerous, however, and few will risk swordfish harpooning without at least one companion.

The distinguishing mark of a swordfishing boat is a plank, fifteen to twenty-five feet long, depending on the size of the vessel, twelve inches wide and three

or four inches thick, extending straight out from the bow and rising at an angle of about twenty degrees from the deck. The outer end of this plank is equipped with a platform, two feet square, surrounded by a waist-high railing of iron pipe firmly bolted in place. A handrail of piping usually is erected along one side of the plank clear back to the ship, though this sometimes is replaced by a strong line, held on pipe supports.

THE platform, which rides ten or twelve feet above the water, and bobs about like the tip of a trout rod, is called the "pulpit." This is the precarious post occupied by the harpooner, who must have a strong stomach, steady nerves, and total lack of fear. Incidentally, he has a quick and sure eye and a strong arm, or he does not remain long in the pulpit. His weapon is an oak-handled, barb-tipped spear, eighteen to twenty feet long. This he does not throw, as does the whale harpooner, but thrusts deep into the back of the swordfish, making sure the barb has "taken hold" before he lets go.

To the head of this harpoon is attached 300 to 400 fathoms of stout line, the free end being fast to a key buoy or float, which is hurled overboard by a member of the crew as soon as the harpooner shouts "Strike!" On some of the smaller boats the harpoon line is made fast inboard, and the swordfish allowed to tow the boat, rather than the buoy, until tired out. When the keg is thrown overboard from the larger boat, it is followed by a man in a skiff equipped with an outboard motor. If the swordfish "sulks" or "sounds," instead of tiring itself by



Three hundred pounds of sea pork, worth on the average 25 cents a pound to the fisherman.

Ready for the kill. The harpoon is driven into the sleeping fish back of the dorsal fin. At the right, the wild hog, in its death agony, hurls itself up so violently that its sword may pierce copper and oak.

long dashes on the surface, the man in the skiff reminds the marine pig of its predicament by heavy jerks on the line, which he picks up as necessary and lets go as quickly when the swordfish resumes its flight.

SINCE these fish weigh from 100 to 1,000 pounds, usually around 300 to 400, and attack whales, sharks, or food-fish with equal impunity and success, the lone man in the thin skiff has no desire to attract the charge of the broadbill. Official reports have been made of swordfish which have driven their weapons through ten inches of copper sheathing, oak planking, and pine timber.

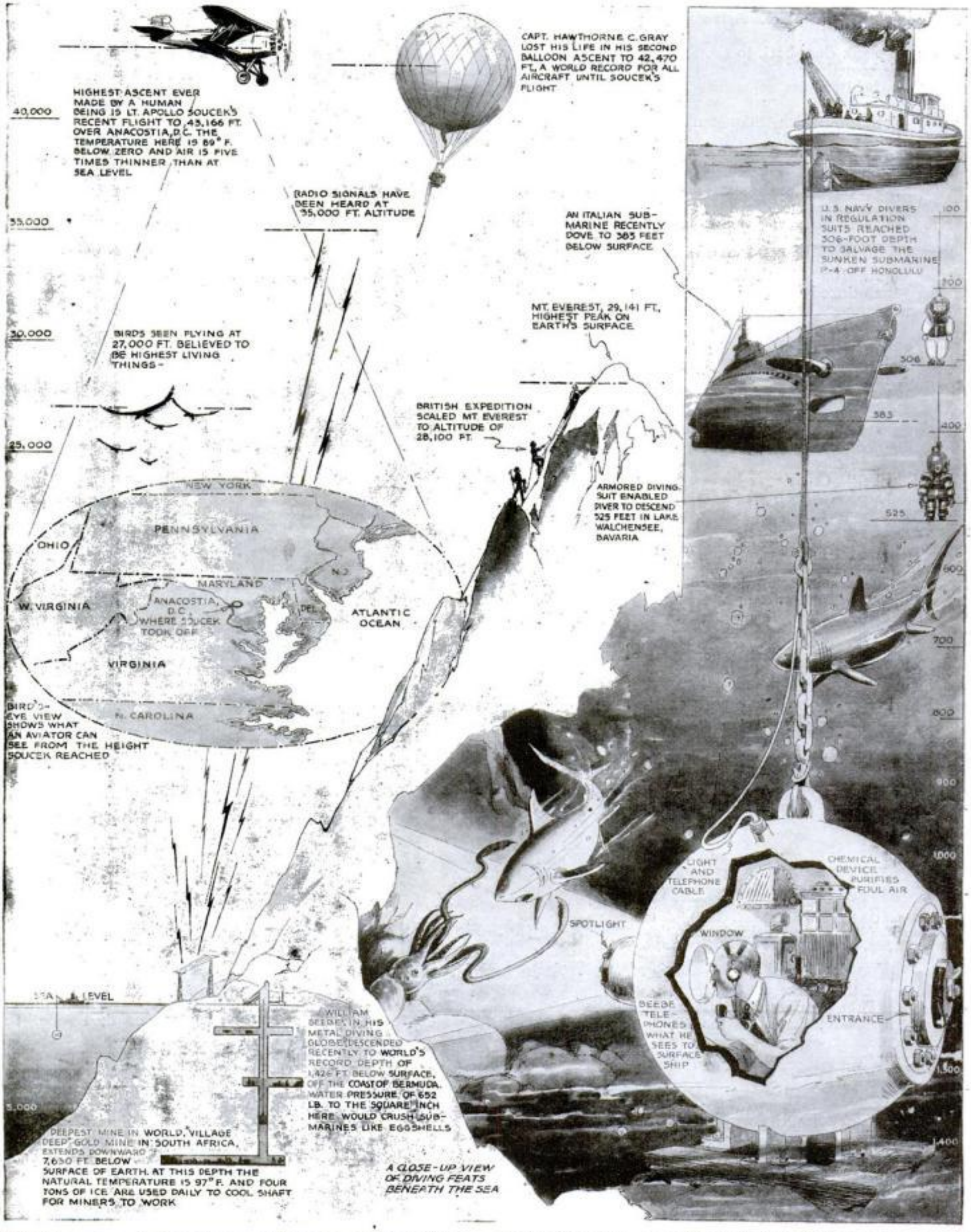
A tuna bait-boat recently returned to San Diego with the sword of a broadbill projecting through six inches of planking and other boarding into the hull. In trying to free itself, the swordfish had broken off the three-foot bone rapier on the outside, and the weapon formed a perfect and water-tight plug for the hole in the hull. It has been suggested by students of these matters that the swordfish mistook the vessel for a whale and charged the hull regardless.

With the hold of his boat filled with crushed ice, the sword-fisherman shoves off from an American port, bound for an unmarked lane, beginning about ten miles at sea and extending 100 miles or so toward the sunrise or the sunset, depending on which side of the continent he fishes. Just whence the swordfish comes or whither it goes are maritime mysteries, and broadbills of less than 100 pounds weight are very rarely reported.

The wild hogs of the sea

(*Continued on page 130*)

Man's Greatest Ups and Downs

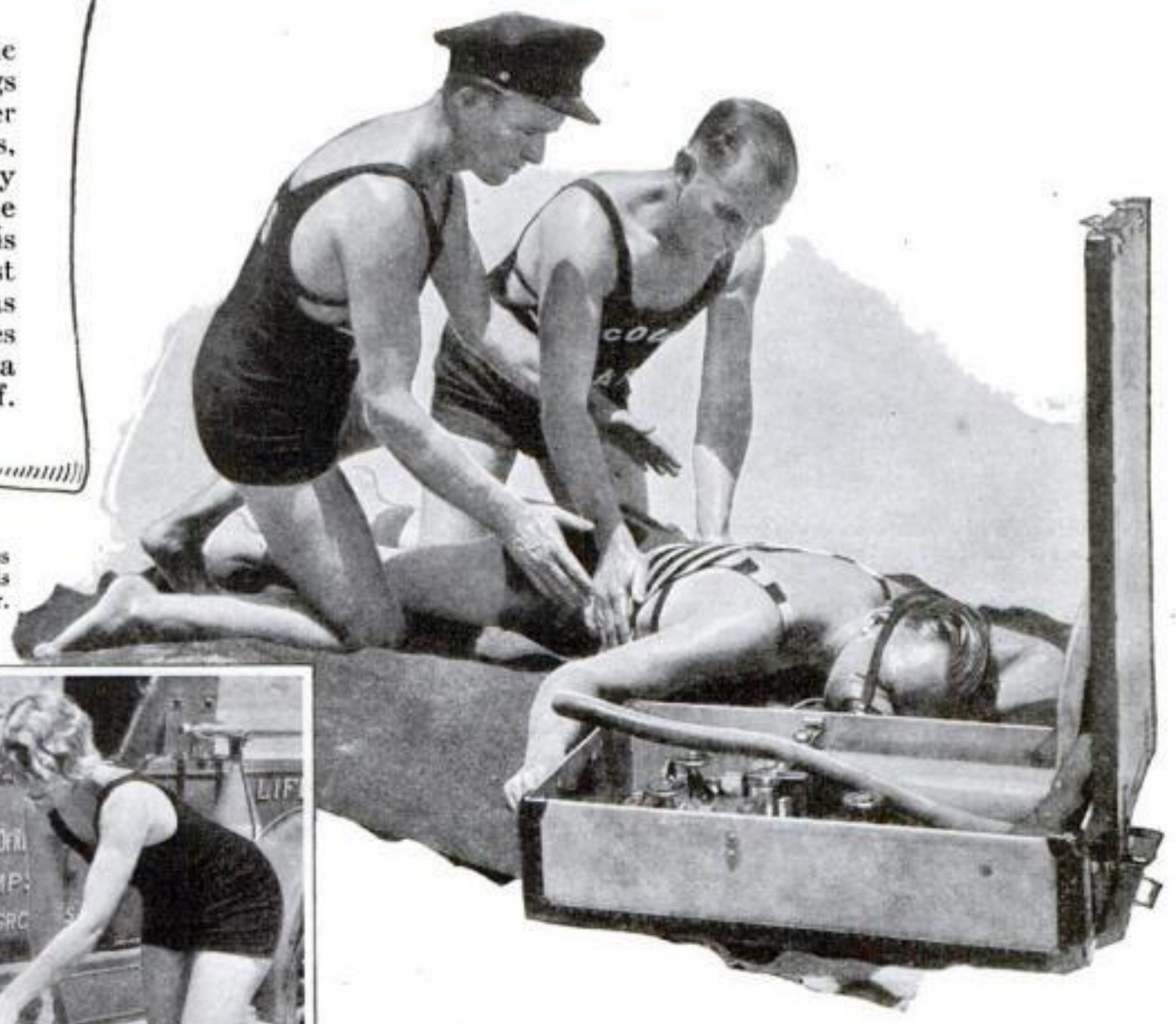


TWO new records recently extended man's conquest of the heights and depths. Lieutenant Apollo Soucek boosted the greatest height ever attained by a human being to well over eight miles in an airplane flight, and William Beebe, noted explorer, plunged to a record depth of more than a quarter mile in an odd metal diving globe. These and other marks of earth, sea, and sky are compared above by our artist, giving you a picture of man's endless efforts to conquer sea sky and earth.

POPULAR SCIENCE SCRAPBOOK

News, pictures, and brief bits about unusual people, places, and things from all parts of the world are shown on the following pages

One way to learn of the odd and interesting things people are doing in other states, and in foreign lands, is to travel. Another way is to read of them in the pages that follow. Here is brought to you a harvest of new sights and ideas from out-of-the-way places that a man might spend a lifetime to visit for himself.



Below, life line and buoy carried by Los Angeles rescue car. At right, two guards working over an unconscious bather.

AUTO RESCUES SWIMMERS

WHEN a swimmer on any part of the Los Angeles County, Calif., beaches is in danger of drowning, a new type of life-saving car comes tearing across the sands to his rescue.

The automobile enables forty life guards to patrol the five miles of beach the county now has, since its recent purchase of three and a half miles. The car was installed for the purpose of making the beaches safe for children and bathers entering the surf.

It is fully equipped with the latest devices, among which are a seven-hundred-foot life line attached to a buoy that is capable of supporting the weight of four persons in the water.

When an unconscious bather is brought to shore, efforts are at once made to revive him with the use of a portable resuscitator that is carried in a suitcase. If the patient does not respond to this treatment, he is carried to the car where another type of pulmotor, permanently installed in the back of the machine, is used to keep him alive on the way to the hospital.

Many persons in difficulty off outlying sections of the beach have been saved since the adoption of the rapid rescue service.

FINDS MANY WILD WEEDS MAKE EXCELLENT FOOD

EATING weeds is suggested by Mary F. Meserve, Nebraska botanist, as possible use for the wild plants covering the swamps and untilled waste lands of the United States. By cooking and eating many of these plants, Miss Meserve has discovered a number of them which she says will appeal to the human appetite.

Among the weeds and wild plants she recommends for eating purposes is the jack-in-the-pulpit. She says that, when cooked and seasoned, the core of this common plant is thoroughly palatable. The cat-tail, growing in marshes in all parts of the country, has a starchy core that can be ground into edible meal. Its young shoots are said to be as tender and choice as asparagus.

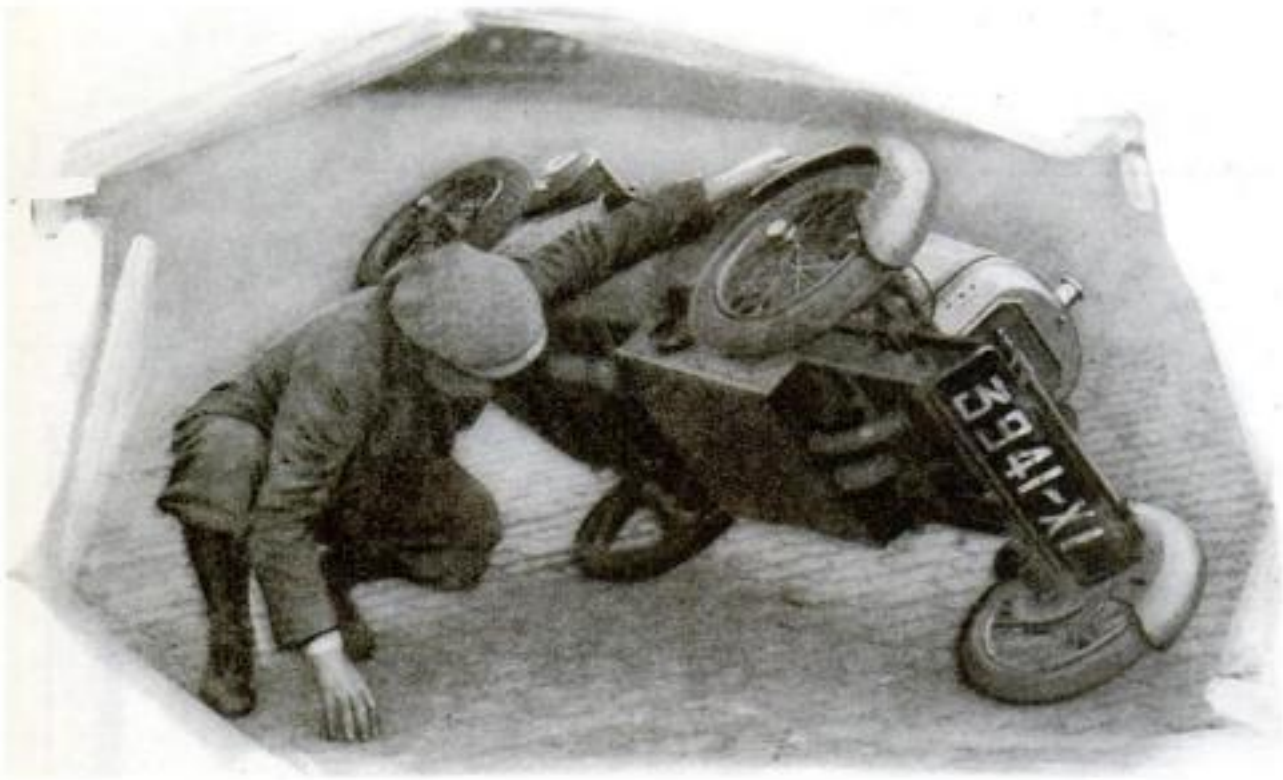
TROOP TRAINS OF SKY TO FIGHT NEXT WAR

INFANTRY armies of the air will be the shock troops of the next war if plans being developed by the British Air Force prove successful. Planes carrying 200 men each, in squadrons capable of transporting a regiment, will rush reserve troops through the sky to points of attack.

Troop airplanes have been successfully used in Mesopotamia, transporting twenty-five fully armed and equipped infantrymen.

The Vickers-Napier airplane company in England is now designing still larger transport planes. The new craft will be of all steel construction armored against gunfire from the ground or attack in the air. Even the propellers will be of steel alloyed with lighter metals. Propelled by eight to ten motors, the new monster planes will have a cruising radius of more than a thousand miles. They will be capable of 125 miles an hour fully loaded. They will mount a dozen machine guns in addition to heavier caliber weapons.

NO NEED TO CRAWL UNDER THIS CAR



This trifle of an automobile was seen recently in Brussels, Belgium. It is so small and light that a jack is not part of its equipment, as in case of need it can be raised easily by hand.

SMALL cars are the rule in Europe, where gasoline comes high, but even Belgian motorists looked twice at this tiny car when it recently scudded down a street of Brussels. Stopping it, the driver climbed out, lifted it with one hand, and thoughtfully inspected the bottom of the chassis.

Fixing a faulty differential or changing the oil has no terrors for the driver of this baby car. Instead of getting out and under, he lifts it up and makes the necessary adjustments. There is no jack in his tool kit, for a block of wood will prop up the car to change a punctured tire.

EXPECT 90-MILE TRAINS

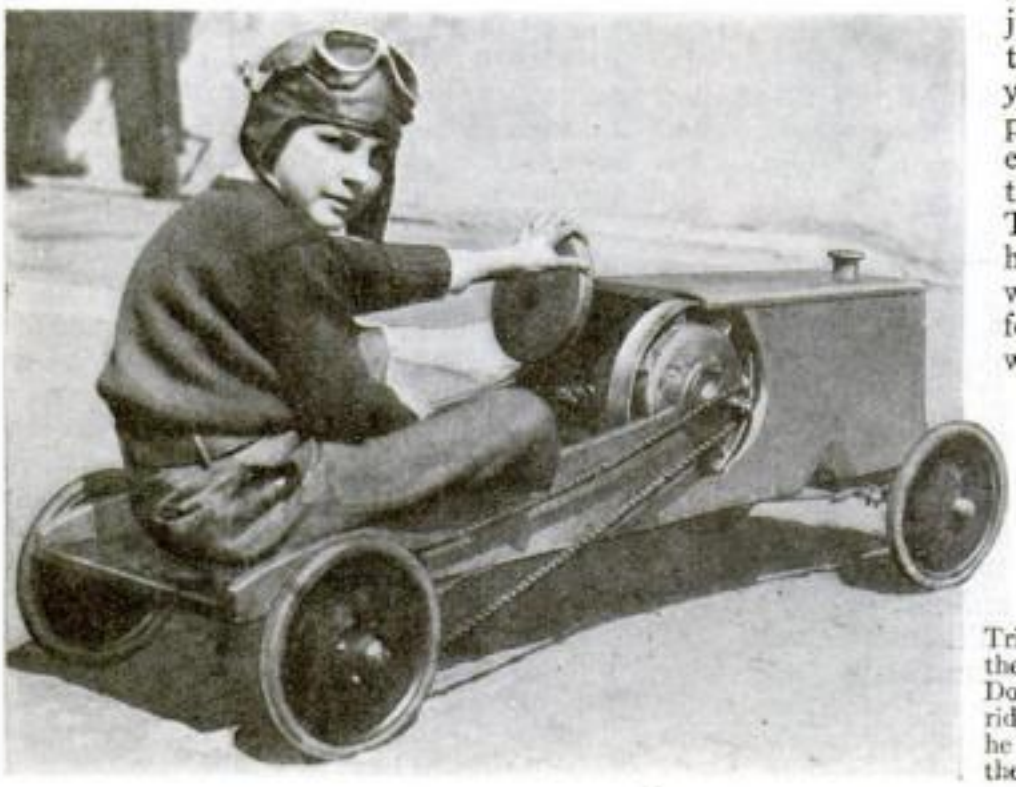
TRAINS running ninety miles an hour, on a fourteen-hour schedule between New York and Chicago, are foreseen within five or six years. The high speeds would result from electrification of one of the main lines, on the section that traverses the Pittsburgh, Pennsylvania, district.

DOLLAR CAR BUILT BY 12-YEAR-OLD

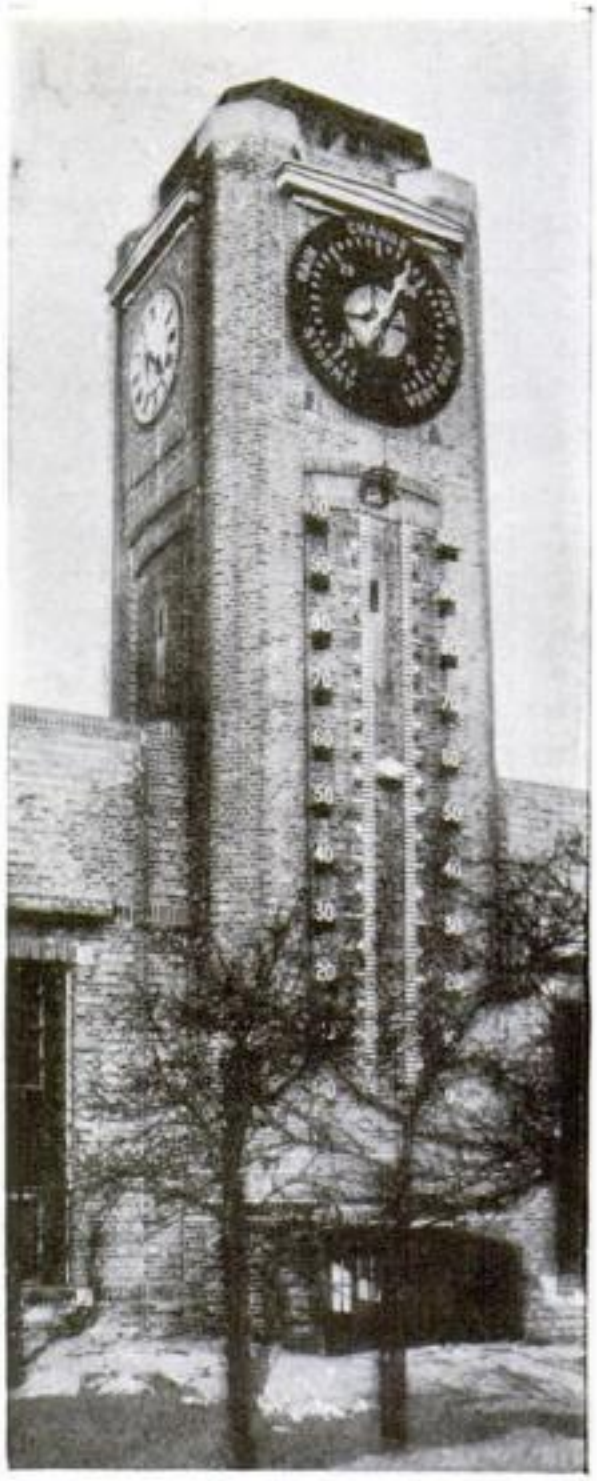
WHEN Robert Dodge, twelve-year-old son of Kern Dodge, a Philadelphia engineer, wanted a car, he built it himself. The materials he used cost only a dollar, and the car runs.

The motive power is a discarded washing machine motor, a three-horsepower gasoline-driven affair of the type used on farms where electricity is not available. The young designer installed the motor amidships in his buckboard, and fashioned a driving chain to one of the rear wheels from a secondhand bicycle chain and sprocket. Since it is chain driven from one hind wheel, there is no need for a differential. A homemade steering wheel attached to a system of cords and pulleys is used to guide the car.

When he is ready to go for a spin, Robert starts his car by giving it a running push. A magneto built into the motor furnishes the spark, and when the motor starts he jumps in. To come to a stop, the youthful driver applies a brake that encircles the motor's flywheel. The gasoline tank holds two quarts, which is enough for a long "drive" without refueling.



Triumphant youth, in the person of Robert Dodge, of Philadelphia, rides in the motor car he built himself at the cost of one dollar.



ENGLISH TOWER TELLS TIME, HEAT, WEATHER

A NOVEL weather tower in Chiswick, near London, is clock, barometer, and thermometer in one. Not only can the observer tell the time, but he can also read the atmospheric pressure and temperature recordings.

The dial of the barometer, nine feet in diameter, is mounted forty-eight feet from the ground, and can be read from a distance of 200 yards. The thermometer, also large, is twenty-six feet long.

As the recording instruments are of usual size, the builders of this tower had to solve the problem of transmitting the registerings to the large external dial and scale. The movements were magnified by means of gears and levers, much in the nature of a huge system of clockwork.

FIFTY WORDS, AVERAGE PHONE VOCABULARY

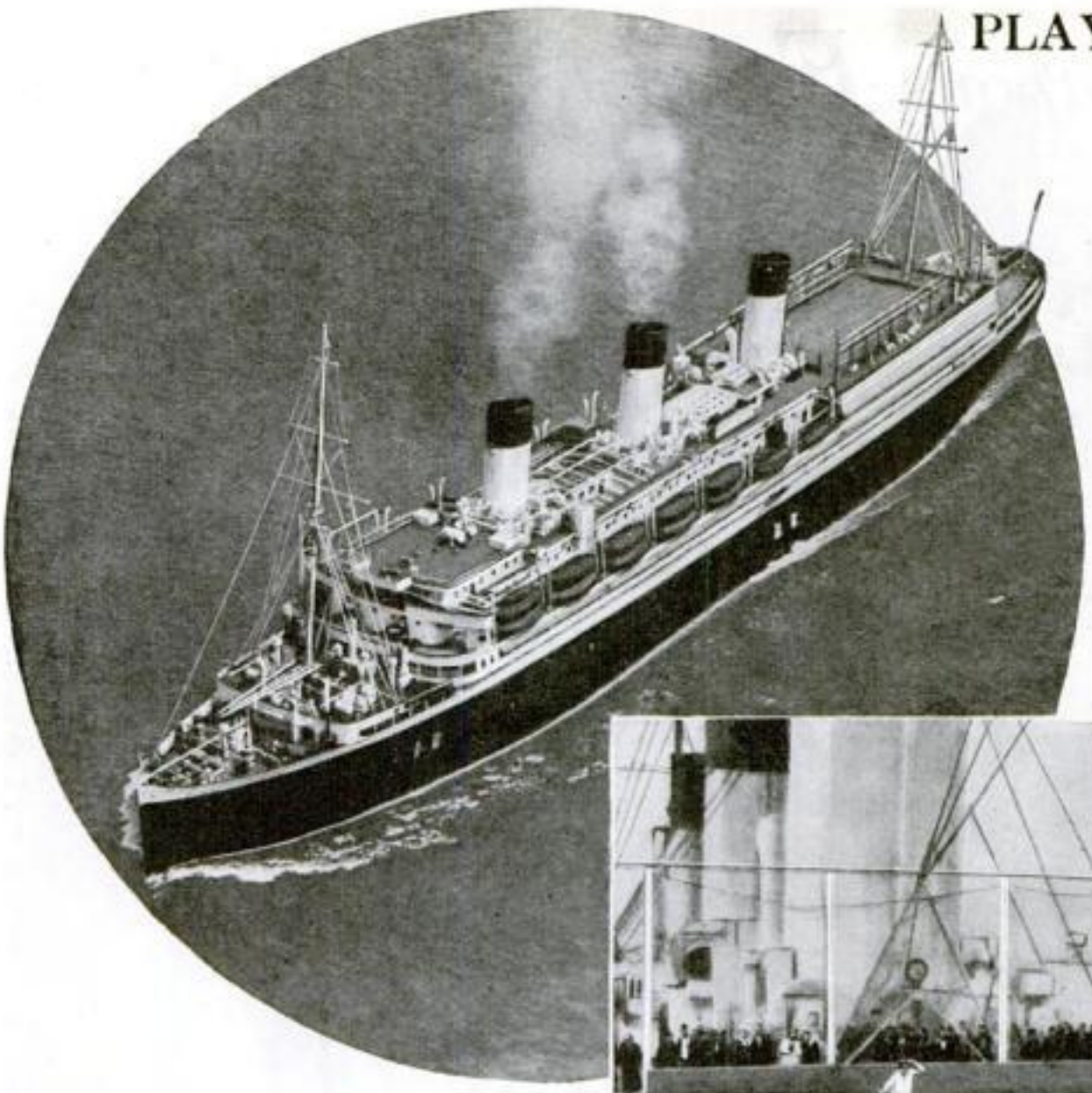
FIFTY words are all the average person uses in a telephone conversation. Only five percent of telephone users need more than 700 words to convey their ideas.

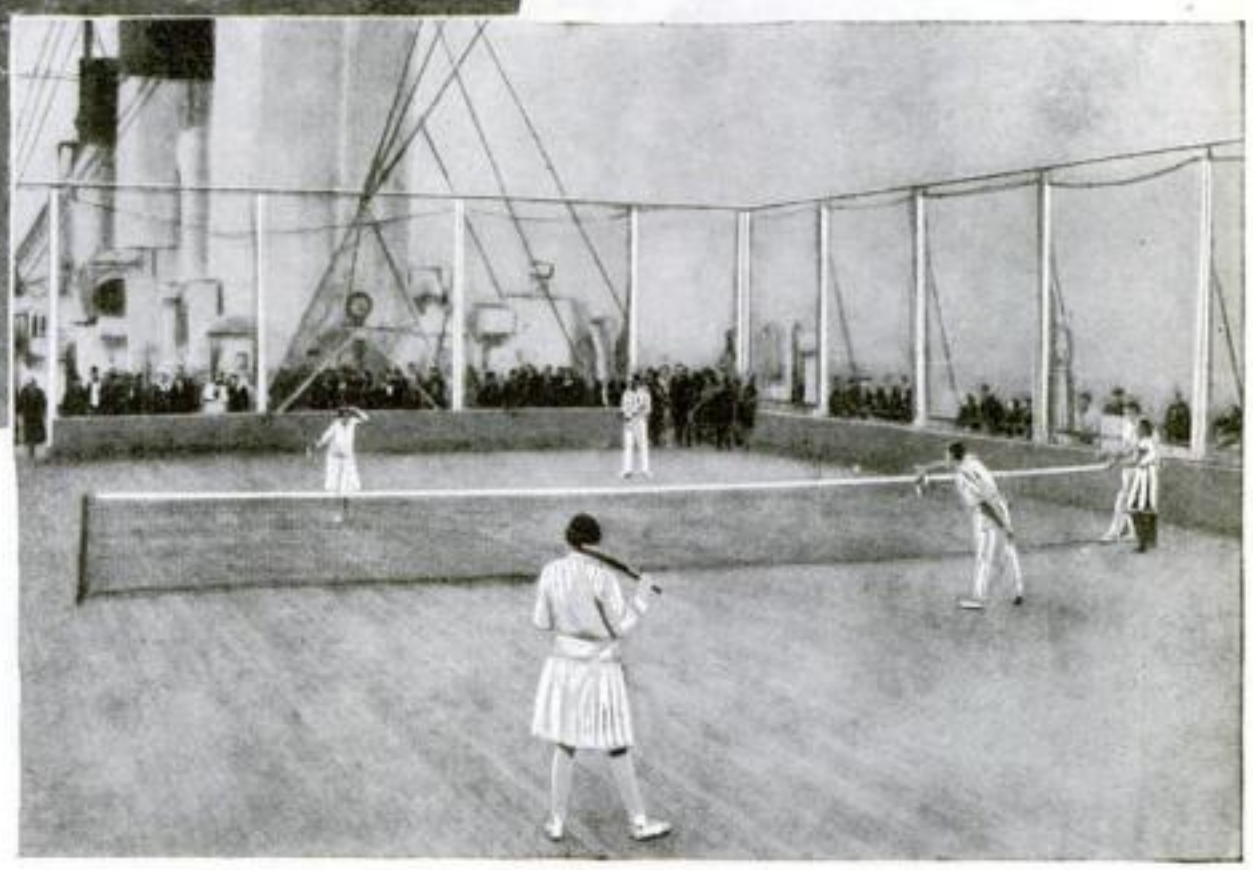
These facts, according to W. P. Banning, American Telephone and Telegraph Company official, show how easily telephone users could avoid misunderstandings over the wire by learning the proper enunciation of these few words.

PLAY LAWN TENNIS AT SEA

TENNIS has at last become a nautical game with the installation of a full-size court aboard a German liner on the South American run. Those passengers who hitherto have had to be contented with the imitation game of deck tennis now have an opportunity to keep in practice on their ocean-going voyages.

The tennis court is installed on the top deck of the liner and occupies a major share of the space just aft the funnels. It is constructed with a narrow wooden planking, much after the fashion of the speedy indoor courts on land. Few balls go into the sea, for high netting surrounds the court. Room is allowed along the length of the court beyond the netting for spectators and those who prefer to take their exercise in walking.





Above, an air view of the liner, *Cap Arcona*, with full sized tennis court back of funnels. Below, passengers play tennis on the net-inclosed court that has been installed on the German ship.

SOME CAUCASIAN SILVER TARNISHES TO GOLD

"GOLD rust" is a novelty reported by Prof. Maurice H. Bigelow, of the University of Pittsburgh.

Professor Bigelow made his discovery when he found that "gold braid," on antique dress jackets from the Caucasian region, were silver. Professor Bigelow suggests that platinum is responsible.

STATUE DOCTOR HAS 1000 PATIENTS

BEAUTY and health treatments for statues is the latest development at the Crystal Palace in England. J. Cheek, known to his friends as "Surgeon" Cheek, has over a thousand statues there in his care and he gives them first aid treatment whenever needed.

In his combination operating room and beauty parlor, he replaces and touches up hundreds of noses, legs, arms, feet, and other portions of a statue's anatomy. In the illustration at the right, Cheek is putting the finishing touches to the head of Queen Isabella of Spain, after lifting her face and in other ways rejuvenating her majesty.

His services are made necessary by the fact that bits are chipped off in the usual wear and tear of keeping the statues clean. In addition there is the slow disintegration of the stone, which occurs regardless of the purity of the marble.

At Crystal Palace, London, more than a thousand statues are in constant need of skilled attention. J. Cheek, their surgeon, is here finishing face of Queen Isabella of Spain.

IF YOU SEE TORNADO, GET IN CAR—AND STEP ON IT

IF YOU see a tornado coming, jump in your car, head down a side road, and step on the gas. That is the official advice of the United States Weather Bureau in a recent report. In level, open country, it says, an automobile can outrun a "twister."

Those violent storms usually can be sighted several miles away, and at once recognized by the peculiar funnel-shaped cloud. Strange tints of green and purple appear in the darker clouds, and as the tornado approaches a terrifying roar is heard that sounds like thousands of railroad cars crossing a bridge.

Despite the enormous velocity of the whirling currents, however, the tornado rarely approaches faster than forty miles an hour. Unless a well-built cyclone cellar is near, the weather man says, the proper thing to do is to escape by automobile. A motorist who heads at right angles to the storm's path can soon be beyond its narrow swath of destruction.

New Weapons Found for Locust War

The locust, really a grasshopper, that has come down like a plague to destroy green things in the Near East.

At left, great piles of dead locusts and, below, wall of zinc that halts the pest. This is one of the latest and best weapons in the war on locusts.

A tank carried on the back contains gasoline under pressure which, lighted at the spraying cone, is used to burn the pests.

Over the scant vegetation in the near-desert regions, Bedouins scatter poison, thus destroying millions of invading locusts.

Above, natives digging wide pits into which the locusts crowd themselves and are then buried alive as dirt is shoveled back over them. In this way millions are killed, but the horde seems vast as ever.

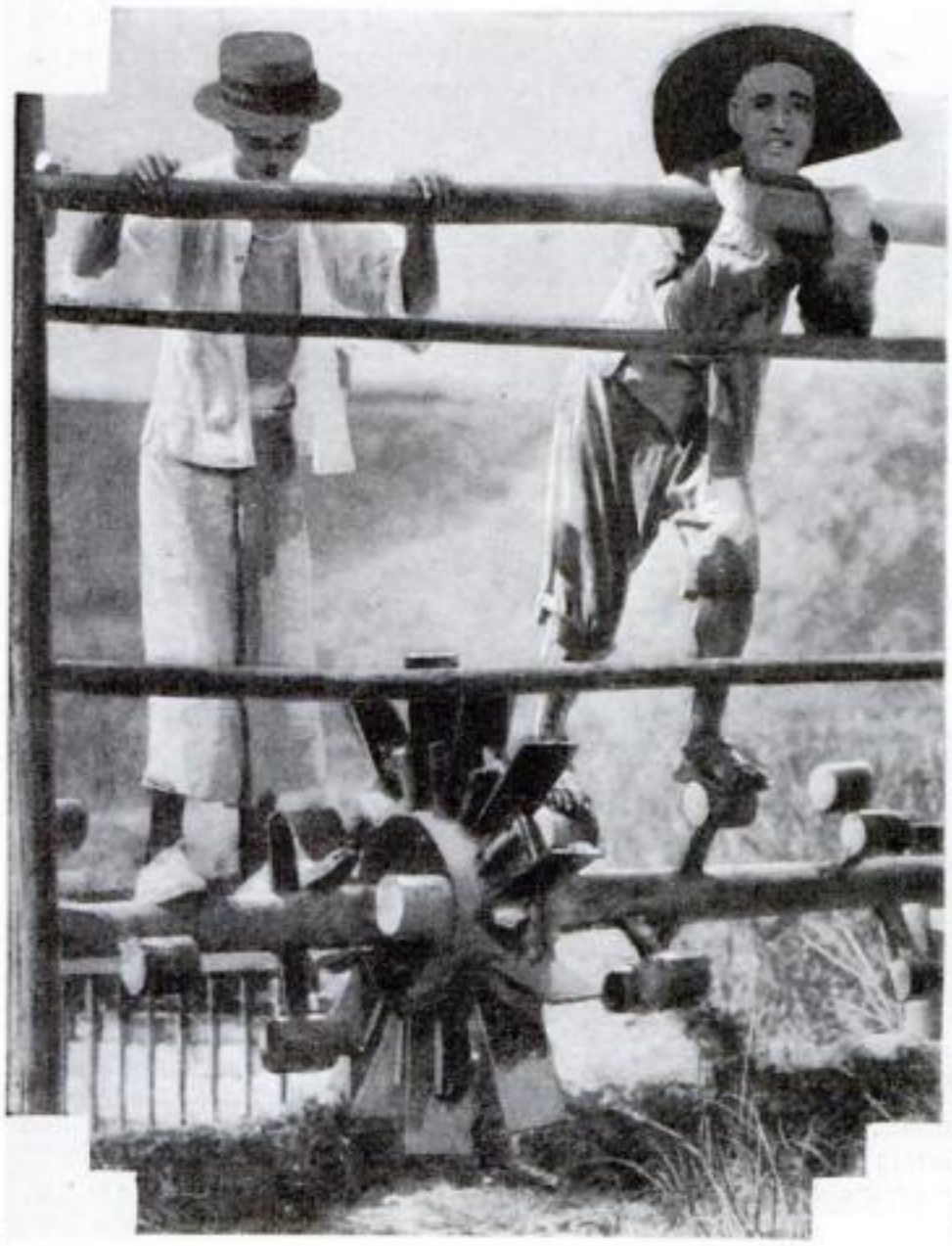
At left, Bedouins, each carrying a bag of sodium arsenite mixed with bran and molasses, are marching into the locust territory where they will spread the deadly mixture over the ground and all plants.

Fast Footwork Aids Toiler in Orient

DYEING IN MOROCCO. Feet play an important part when an Arab is coloring cloth. He dances on the fabric to stamp in the dye.

BRAIDING WITH BIG TOE. Toes are toes in Indo-China and in braiding a rope the fiber is held taut with the foot while the hands do the weaving. Coconut palms furnish the material.

TWO EXTRA HANDS. At left, the Morocco native is making a basket and so skillful are his feet that he really has four hands. His toes hold the reeds in position so his fingers can plait them firmly.



IRRIGATING BY FOOT. An ancient Chinese custom sets these natives tramping a treadmill pump that raises water to flood the rice fields. It must be good for they have been doing it in the same way for two thousand years.

TREADING OUT THE VINTAGE. Natives of Palestine crush grapes with their feet, treading the juice out in big vats. As these people are Mohammedans, the wine they thus make is used only for religious purposes, but Europeans formerly made beverages in much the same manner.

MOVIE GETS WORLD'S BIGGEST MURAL

A mural painting, containing 5,000 square feet, is being made by Rockwell Kent, artist, for a new Cape Cod motion picture theater. Photograph shows the artist laying on the colors with a big brush.

WHAT is said to be the world's largest mural, a painting of 5,000 square feet, is now nearing completion. It will be hung about the walls of a movie theater on Cape Cod, Mass. Rockwell Kent, artist, and Joe Meilziner, designer of stage settings, are the creators of the canvas, the work on which is being done with the kind of brushes ordinarily used by house painters.

In addition to the artists, ten technicians are at work upon the canvas, which, set up in the street, would cover the fronts of three five-story buildings.

AUTO DARE-DEVILS RACE AND TALK

RUBBER tubes connecting the mouths and ears of the drivers and mechanics of racing cars and thus making conversation possible have come into use with the return of two-man cars to the international 500-mile race at Indianapolis, Ind.

This device is borrowed from the aviation world, where it was extensively used in the training of new pilots before the introduction of the electric two-way conversation telephone system now widely employed.

A metal cone is worn by each man in the car. This fits over the mouth and is attached to the end of a rubber tube leading to the receivers located in the ear coverings of the other man's helmet.

Tube from mouth leads to receiver in racer's helmet, making possible conversation in spite of speed.

WOMEN'S NOISY DRESSES HELP PUBLIC SPEAKERS

WOMEN'S dresses are getting louder and louder. The United States Bureau of Standards, which makes this statement, is not referring to their color scheme but to their actual ability to absorb or reflect sound waves.

The fact that a woman's dress absorbs a certain amount of sound is important to the builder of a theater, since unless his auditorium is correctly designed the audience's clothes will muffle the voices of the actors. Therefore the Bureau of Standards made exact measurements of the ability of clothes to deaden the sound of the voice. Wool clothing which grandmother wore was an effective silencer, according to the sound experts, for it rated 4.7 units in the sounding test. But the silken dresses of modern style absorb only 2.2 units. In other words, a speaker on the stage has a much better chance of making himself heard by those in the back row when his feminine audience is wearing up-to-date clothes. He should prefer an audience of women, too, for men's clothes will muffle his words almost as effectively as grandmother's dresses, especially if he is wearing an overcoat.

In this same connection, experiments at Colgate University showed that the natural rhythmic action of the stomach is one third suspended by a loud racket, as that of a boiler factory, and it does not resume its normal movement until some time after the noise ceases.

DRY ICE DUST, SCATTERED BY PLANE, BRINGS RAIN

CAN anyone make it rain? Recently A. Veraart, Dutch inventor, flew over the island of Marken in the Zuider Zee. At 8,000 feet, he dumped out a ton and a half of "dry ice" powder, a refrigerant used for packing ice cream. Rain fell upon Marken. The cold particles of powder, Veraart said, condensed moisture about them, producing raindrops.

His one success, however, was preceded by many unsuccessful efforts. He is trying to find a way to dispel clouds in rain and allow sunshine to follow.

BIG THYROID GIVES BOOZE QUICK KICK

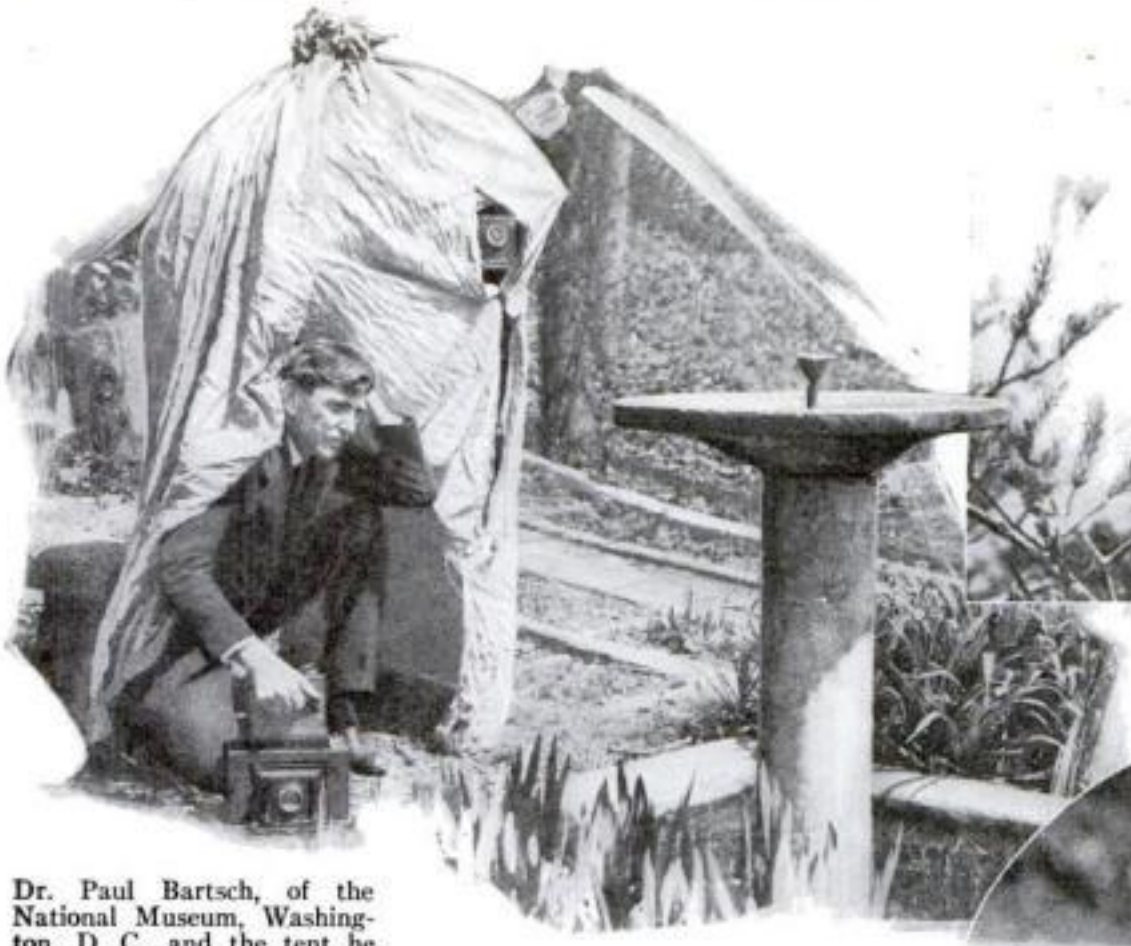
THYROID glands decide how people "carry" their liquor, according to Dr. Ludvig Puusepp, neuro-pathologist of Esthonia. The larger one's thyroid, a ductless gland in the throat, the more quickly drink affects him. If the thyroid is small, one "can drink almost any amount of alcohol," he reports.

WHALE'S PICTURE MADE AT BYRD'S POLAR CAMP

WHEN this whale came up for a breath of air, he didn't know that a few feet away from his huge nose would be a photographer of the Byrd expedition waiting to take his picture. The rare photo was one of the most striking recently brought back from Little America, which was Rear Admiral Richard E. Byrd's Antarctic camp during his months of exploration.

The whale, along with penguins, petrels, and gulls, was one of the visitors to the rim of the ice pack where Byrd camped.

This big fellow got his nose above water and at that instant Admiral Byrd's photographer caught him.



Dr. Paul Bartsch, of the National Museum, Washington, D. C., and the tent he uses to photograph wild birds.

A nighthawk, silently meditating upon the strange ways of the world, had no idea that he was posing for an interesting photo.

This olive-backed thrush was caught by camera just as it was on the point of taking a refreshing dip.

BIRDS SNAPPED FROM TENT

INVISIBLE beneath an "umbrella tent" which he has built, Dr. Paul Bartsch, ornithologist of the National Museum at Washington, D.C., snaps rare photos of bird life.

When he found that a bird bath in his garden attracted frequent visitors, he erected the tent a short distance away. Then he spent many hours hidden within it, his camera ready for a chance shot through a peephole. On one red-letter day he photographed seventeen different varieties of birds in a quarter of an hour.

So successful is the novel tent that Dr. Bartsch has taken it with him all the way around the world, and on a dozen trips to the West Indies. The pictures on this page show two of the close-up bird photos he obtained.

RADIO MAY BE USED TO SPEED UP BRAIN

WILL the big business executive of 1940, about to make a million-dollar decision, retire into a "thought chamber" where radio tubes will warm up his brain?

Recent German experiments indicate that this is a possibility, declares O. H. Caldwell, former Federal Radio Commissioner. When two German experimenters, Prof. P. F. Schilder and Dr. E. J. Kraus, applied very short, or high-frequency, radio waves to the brains of animals and human subjects, they observed that the gentle internal warming which resulted speeded up mental processes. A similar method is used in an American radio device to produce artificial fevers (P.S.M., Aug. '30, p. 32).

"While results are not yet conclusive," Caldwell says, "it appears that extension of this method of electrically heating the brains of ordinary mortals may in the future indeed make 'men like gods.'" He visions, within a decade, "thought chambers" where an executive will let short radio waves stimulate his brain.

One of the world's largest buildings is an illusion as seen in New York from Brooklyn.

YOUR EYES ARE FOOLED BY PHANTOM BUILDING

NEW YORK CITY has a "phantom building." The structure in the picture at the left is an optical illusion, but if it really existed it would be one of the biggest in width and height in the world.

Actually, the observer sees two buildings. In the background is the recently-opened Manhattan Company Building, the tip of its flagpole 920 feet above the ground. Another office building near the water front, seen in the foreground of the picture, supplies the "phantom's" base.

The illusion can be seen from the foot of Pineapple Street, Brooklyn, N. Y., on the opposite shore of the East River.

POPULATION OF WORLD OVER TWO BILLION

THE world's population is growing. Recently it passed the two-billion mark, according to figures collected by the International Statistical Institute at The Hague, Holland. One out of every twenty persons in the world is an inhabitant of the United States, the figures show.

If a world congress of one hundred men were chosen on the basis of population, North and South America would be represented by thirteen persons, including five from the United States. Fifty Asians would be there. Europe would send twenty-nine representatives. The African delegation would number eight. Australia has so small a population that it would have no representation.

LEARN YOUR FLYING YOUNG!

Surrounded by a group of embryo flyers, eager to learn air secrets, Enslow rests a pencil on the ground and shows them how the stick is moved and what happens as its position changes. Remembering his own youth, this great pilot is always ready to help the boys who ask him questions.

By
RANDY ENSLOW

Flying Is Youth's Game, Says Veteran Pilot Who Barnstormed with Lindbergh

Enslow, who was a "grease monkey" at a St. Louis, Mo., field, shows Paul Clough how to clean a plane.

ONE of the best students I ever had was a young milkman. I taught him to fly for nothing and paid him $25 a week to learn. This was the way of it:

I had an OX-Standard at the airport at Rochester, N. Y. Every time I came to the field, this milkman was hanging around. He was a ring-tailed pest. He asked a million questions, and he was always begging me for a ride. Finally, to get rid of him, I decided to take him up and give him the scare of his life.

At 3,000 feet, I put the ship into a snap roll. When we straightened out, I looked around, expecting to see the milkman with his head hidden in the cockpit. Instead, he was grinning from ear to ear. I looped the loop and looked back. He was eating it up. I pulled up the nose and let her spin for 500 feet. He had the time of his life. He just wouldn't scare.

When I landed, I knew he was going to be a pilot even if I had to teach him for nothing. But it was worse than that. He told me he had just got married and had lost his job on the milk route. So I had to grubstake him while I taught him. He took to the air like a bird and learned in record time. Now he has charge of five or six planes for a New York flying club.

He was young, only about nineteen, and that helped. For, in flying, the earlier you begin the easier it is.

THE Department of Commerce requires that a student must be sixteen years old before he can enroll in a flying school. But in several ways those under that age can make progress toward being pilots. By spending as much time as possible at airports, listening to pilots talk, and watching students make mistakes, they can learn a great deal about what *not* to do in the air. Then, when they enroll for flying instruction, valuable time is saved. You can't learn to fly by watching somebody else. You have to be in a ship yourself. But you can save time by noting the things to avoid.

Another thing you can do is to get into athletics and build up your health. The way a pilot flies depends upon the condition he is in, so his health is important.

A third step is to make as many passenger hops as possible. Usually, a rookie at a flying school has to be taken up a couple of times just to get him used to being in the air. He has to get over the idea that he is going to fall or that the wings may break off, before his training really begins. If a new student has been up a number of times before he enters a school, he can start training at once. He isn't a cat in a strange garret when he goes up on his first instruction hop.

At Roosevelt Field, young Paul Clough, of Garden City, Long Island, has been getting this kind of a head start. For two or three years, he has been hanging around the field. He probably knows more famous pilots than any other sixteen-year-old high school boy in America. He helps around the planes and carries messages for the pilots.

Frank Goldsborough in the cockpit of the plane in which, at 19, he set a junior cross-country record.

WE ALL take him for rides. He has more than 200 hours in the air as a passenger, and knows how to handle the controls like a veteran after the ship has been taken off the ground.

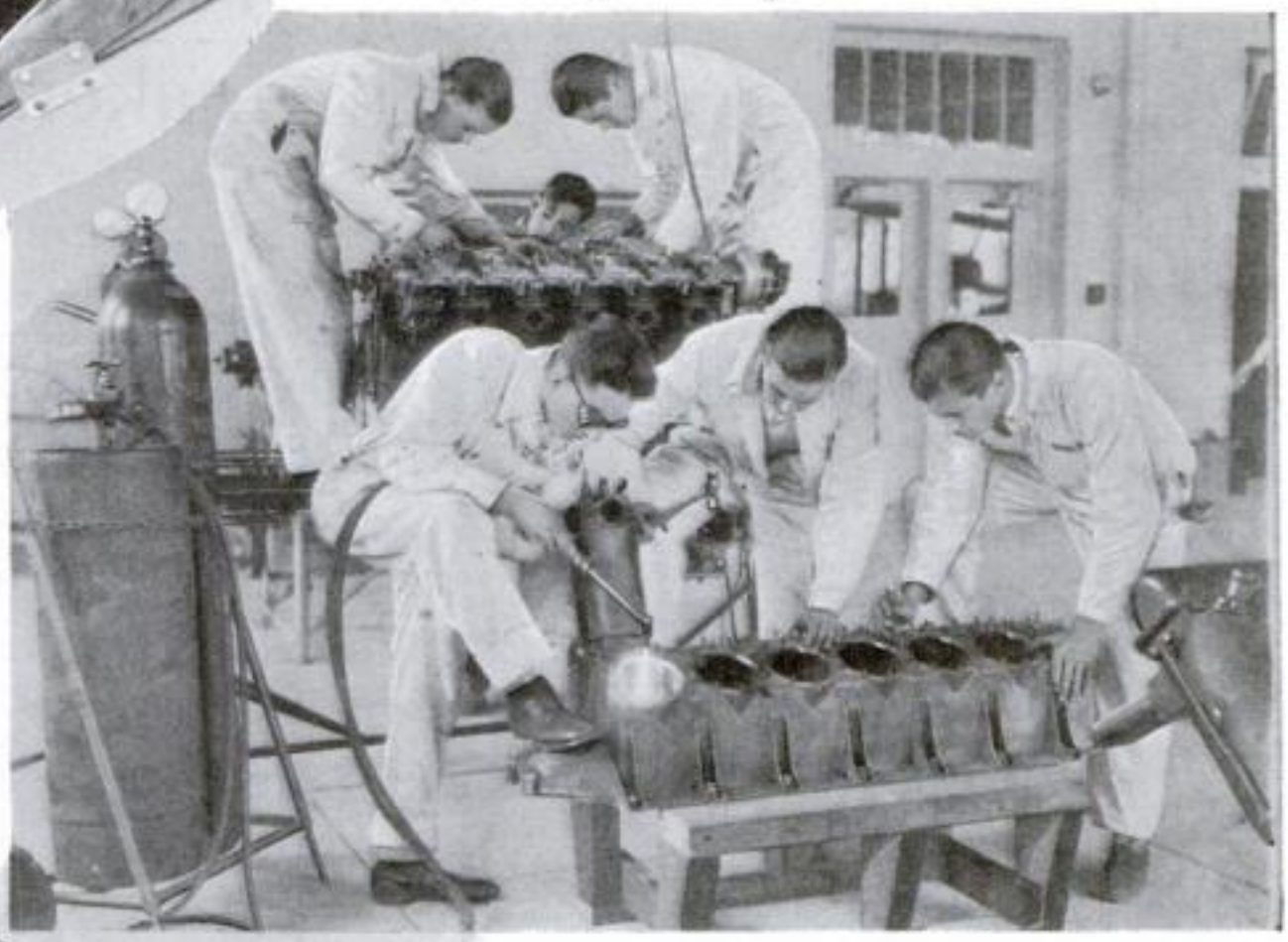
Now, he has saved up enough money to take six hours instruction to learn landings and the fine points of piloting. He will solo in that time. I have noticed that young folks who have to struggle to get enough money to get into flying make better pupils than rich children who take up piloting as a sport.

Aviation is a young person's game. You don't have to grow whiskers before you reach the top. Lindbergh was twenty-five when he flew to Paris. Elinor Smith was breaking world's records before she was eighteen. Frank Goldsborough, a few weeks ago, flew from coast-to-coast twice. And he is only nineteen. The English girl, Amy Johnson, who made one of the most spectacular long-distance flights ever accomplished when she recently piloted a patched-up secondhand light plane from England to Australia, is only twenty-seven. There are many more young ones.

This girl is one of the best examples in the world of a quality every young person who wants to become a pilot must have. That is enthusiasm. She was pounding a typewriter in a London law office when the flying bug bit her. She gave up swimming, dancing, and tennis. She saved every penny she could, about $1.25 a week, in order to get in a half-hour flying lesson every two weeks.

SHE joined a flying club. She helped rig ships and take down motors. She had to work at her office from nine in the morning until five in the evening. But from six to nine A. M. and from five to eleven P. M. she spent around planes.

She wanted to know everything there was to know about ships and the motors that ran them. She wore greasy overalls and she didn't skip the dirty work. By the time she got her license, she knew planes inside and out. It was this knowledge that helped her through when she hopped off in a two-year-old Moth, that had done 35,000 miles before she saw it, on a 10,000-mile flight to Australia. Before that, her longest cross-country flight had been 150 miles.



Students at the George Washington High School, in Los Angeles, Calif., learn how to repair motors.

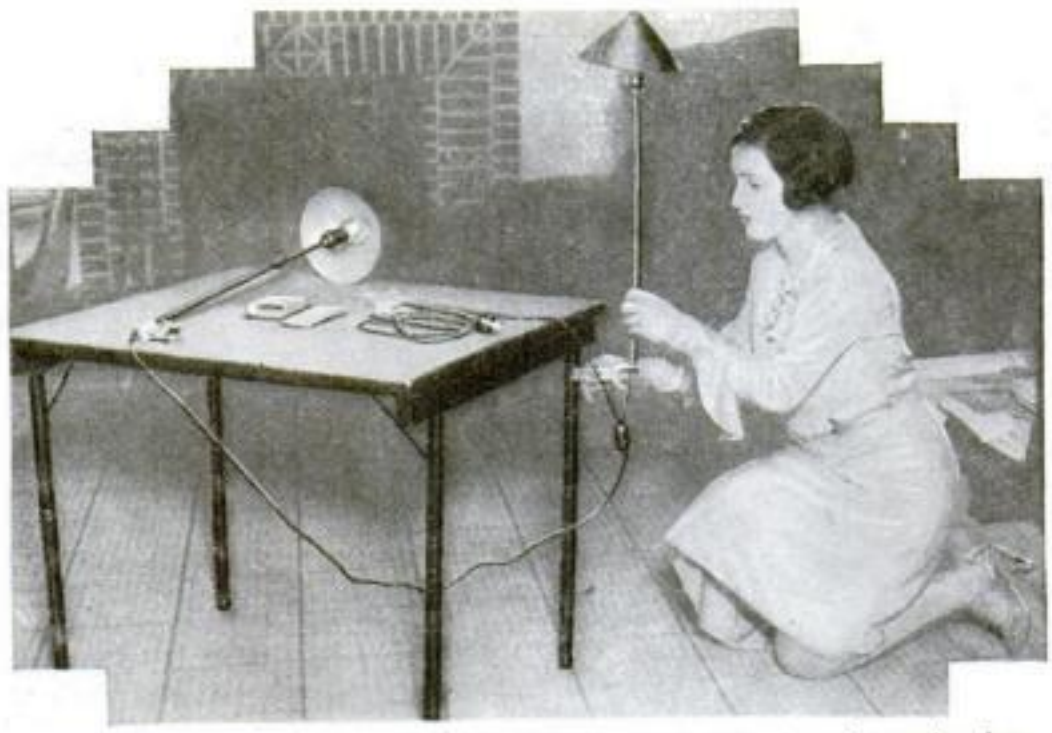
Every airport has its group of enthusiastic boys whose greatest delight is to watch the planes as the pilots send them through the air. This is a good way, says Enslow, to get valuable aeronautical facts.

Being "crazy about aviation" is a long step toward being a pilot. The most enthusiastic would-be pilot I remember was a kid by the name of "Nick" Algrim. He was sixteen or seventeen years old. He used to hang around the Jamestown, N. Y., flying field morning, noon, and night. He would do anything to help.

When he heard I had to make a hop back to St. Louis to ferry through a new Lincoln-Standard five-place job, he stuck to me like a burr in a woolen sweater, begging to go along. I told him no at least 300 times. But on

(Continued on page 128)

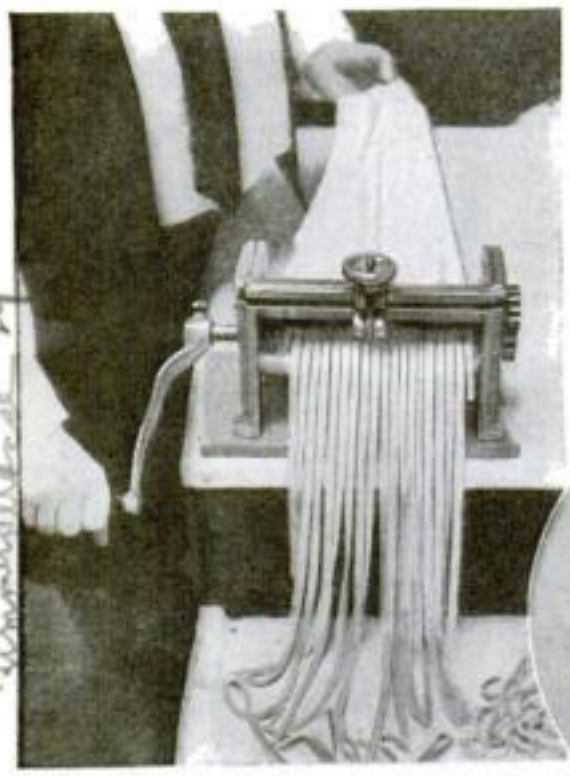
Any standard sized can of household cleanser fits in this convenient holder. It is a handy kitchen accessory and does not leave rust stains.



Bridge tables are brilliantly lighted while the top is left clear for cards when these lamps, mounted on standards that clamp to the table legs, are used. They can be swung toward the center of the table and still be out of the players' way.

Here's a new way to turn your can of condensed milk into a pitcher. This holder has a clip with points that pierce the top of the can and then close the holes until pressure with the thumb raises the lid. The milk can't spill with the lid closed.

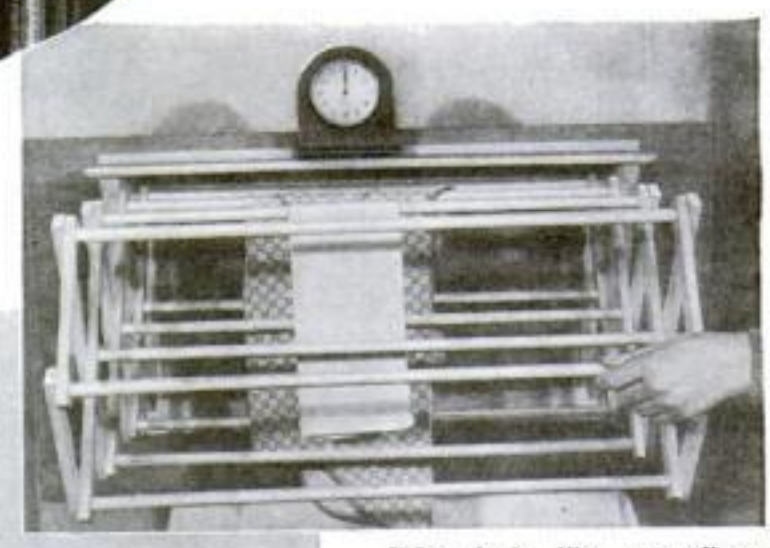
New Ideas of Interest to Homemakers



Making noodles by the yard is easy with this German machine. When dough of proper consistency is fed into it, the turning of a crank forces it between sharp knives so that it emerges in long strips of even width all ready to be used.

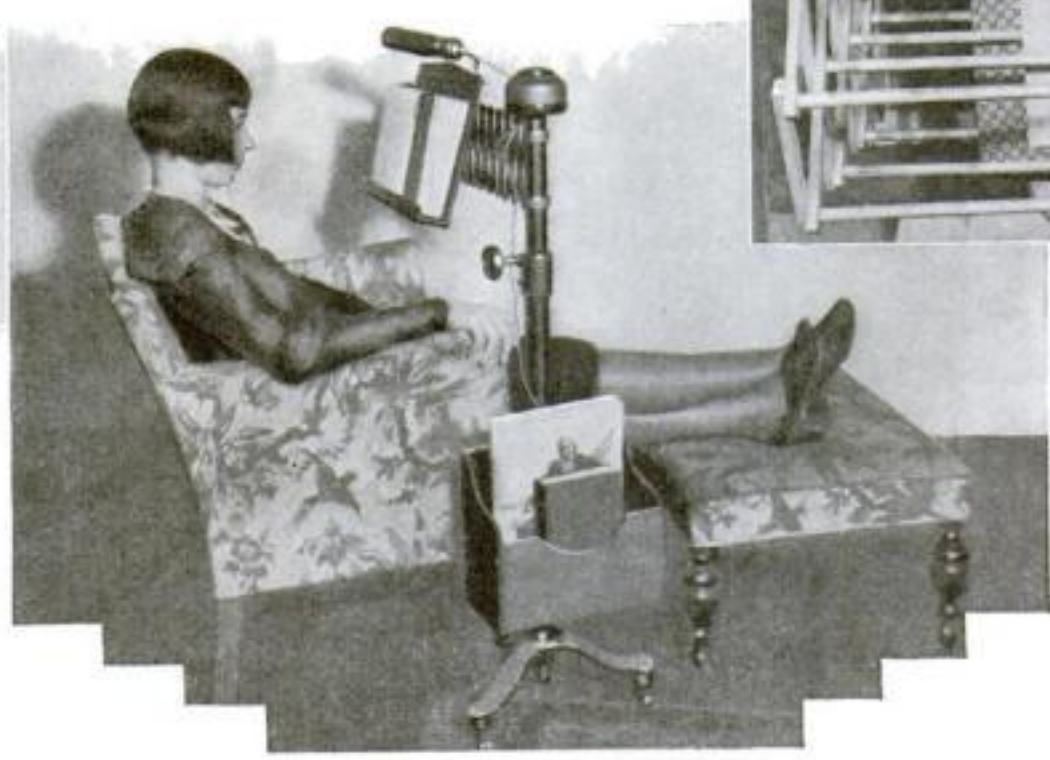
This invention by an Englishman makes the radiator do something beside heat the house. A warming oven is built right into it and when the door is closed food can be kept hot or plates warmed without taking them to the kitchen.

Tubes are said to last longer if your radio cabinet is supported on these sponge-rubber shock absorbers. Also, it is claimed, noises due to vibration of building or floor are eliminated.



What looks like an ordinary kitchen shelf proved to be, when extended, an unusually large rack upon which clothes or towels can be dried. When folded, it disappears beneath the shelf

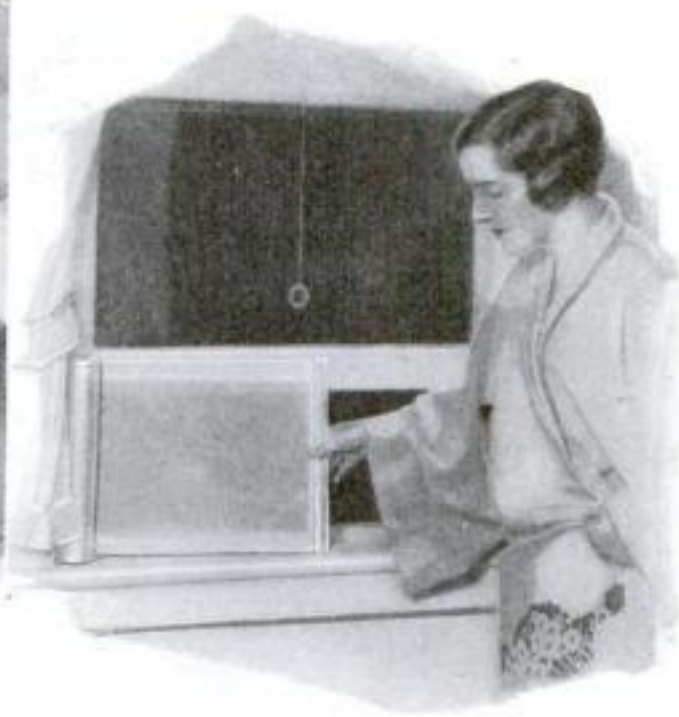
Prodding the paper cap out of a milk bottle is unnecessary if you have one of these metal clips. A sharp point on the clip catches the cap and when the thumb lever is pressed down the cap rises to permit pouring. In this way it is neither lost nor soiled.



Solid comfort for housewife or tired business man is assured by this device at left. Its adjustable arm holds a book at the right distance for reading while its lamp lights the page. An ash tray is attached and its base is turned into a rack to hold magazines or books for reading.

Fiber dust bags for vacuum cleaners do away with the messy job of emptying out the dirt. The fiber bag, with dust and all, is simply thrown away. Hose and clamp attachment adapt them to any type of cleaner.

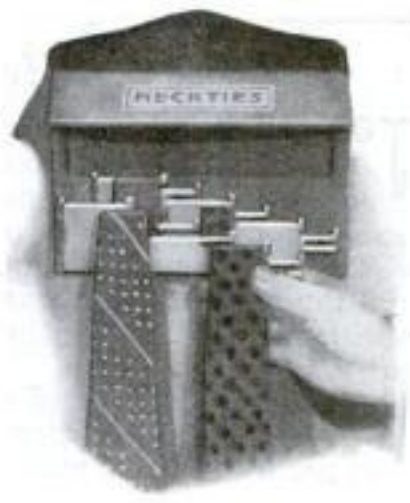
Poisoning from escaping gas is impossible when this shield is fitted to your gas burner. Placed over one row of holes, it keeps the wind from blowing the flame out. No screws or bolts are needed and it remains permanently in place.



Attached to a roller like a window shade, this ventilator vanishes into its case when not in use. When the linen screen is pulled out and hooked in place, it stops drafts and keeps out the wind and rain

Something new in the egg beater line. Its perforated whipper is tilted and bowl shaped to use the principle of the old-fashioned whipping spoon, speeded up to beat eggs or whip cream in record time.

Upholstered in leather, this wickerware seat has the additional virtue of being a clothes hamper, ventilated to prevent mildewing. Especially adapted to small apartments and bungalows, where space is scarce, the combination has a twofold usefulness.



Neckties are held in plain view on this rack and each one can be removed without disturbing the others. Horizontal slots on the swinging arms hold the ties. A box at the top is designed for holding collar buttons and tie clasps.

This corn grater, at left, fits over a pan and when an ear of corn is drawn across its knives, the kernels, sliced off neatly, drop through a slot into pan.

This tiny sharpener is credited with putting an edge on a razor blade in a jiffy. The blade is drawn through the jaws of the device and is then ready for use. The jaws are made of smooth steel and any standard type blade can be thus sharpened as is shown in the illustration reproduced below.

Popular Science MONTHLY

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When the Helicopter Rises

NO MATTER how much more efficient the airplane may become, it cannot, because of the principle on which it operates, satisfy the instinctive longing for the mastery of the air which is planted deep in the human imagination.

When one dreams of flying, the dream invariably centers around the delights of hovering gently over the ground with the satisfaction of knowing that one can land where and when one wills.

The breath-taking rush of the airplane take-off, the bone-rattling bumps of a high-speed landing, and the vast amount of space needed for these maneuvers are basic requirements for flight where lifting power depends on speed.

Curiously enough, few people realize that from a strictly theoretical point of view all this speed is quite unnecessary. If an airplane engine is sufficiently powerful to lift a given weight from the ground by means of an airplane it also is capable of lifting the same weight straight up if only some practical means can be found to give it the proper toe hold on the air.

Since the thing is not theoretically impossible, it is only a question of how long we must wait for some form of helicopter that will give us mastery of the air without the speed of the airplane or the vast bulk of the Zeppelin. Perhaps some of the novel principles of construction embodied in the helicopter described on page 20 contain the key to the solution of this problem.

Our $10,000 Award

MANY readers have written in for information concerning the status of POPULAR SCIENCE MONTHLY'S $10,000 Award for the year's outstanding achievement in science. Our reply to one of these inquiries will be found in the "Our Readers Say" department in this issue. As it is impossible to answer all of the letters individually, we take this opportunity to acquaint our readers with the facts.

Since last January, when establishment of the prize was announced, the Committee of Award, under the chairmanship of Dr. Frank B. Jewett, vice president of the American Telephone and Telegraph Co., has been preparing for the prodigious task of selecting the prize-winning accomplishment.

Through universities, research laboratories, scientific societies, and prominent individual scientists in all parts of the country, the field of science has been thoroughly organized and scrupulously surveyed. A large number of nominations for the Award have been made through these agencies, and now that the period covered by the Award has elapsed, the Committee is considering the claims of the candidates. Announcement of the winner and details of the first bestowal of the annual prize will be made this fall.

POPULAR SCIENCE MONTHLY is deeply gratified by the reaction created by its establishment of the Award, which has been hailed by scientists and leaders in government, industry, and business as one of the greatest boons that has ever come to scientific activity in the United States.

Unconscious for Twenty Years

CONSIDERING that virtually every human being is doomed to spend approximately a third of his entire life span recumbent and sunk in oblivion—in other words asleep—it seems strange that so little is known about this so familiar and yet so strange state of existence.

Why should we waste an average of twenty years in bed? Cannot some way be found to renew the mental and physical vigor of the human machine without such a seemingly senseless waste of time, our most precious possession?

When an automobile runs out of energy in the form of gasoline, it takes only a minute to pour in a supply good for many hours of running. Other forms of inanimate machinery are equally efficient.

Perhaps a start has been made which will help to solve the problem in the experiments described in the article on page 22. The number of times a sleeper moves during a night may not seem important, but it may turn out to be the A B C's of a knowledge of sleep that will abolish sleep altogether.

Good Old Vitamin-A

THERE is nothing new under the sun. The ancient Chinese had fireless cookers and are believed to have invented printing and gunpowder centuries before the Europeans; the Mayans built skyscrapers and had a calendar more nearly accurate than ours; the Egyptian pyramids and Roman aqueducts are still unsurpassed as masterpieces of engineering.

And now comes Monsieur Francois Latry, famous chef of the Savoy Restaurant in London, and tells us that the French chefs of 150 and 200 years ago knew the value of vitamins without knowing them by name. They would not have recognized Vitamin-A (the rickets-preventing element found, for example, in cod liver oil) even if they had stumbled over it, but it would be difficult to find one of their menus, says Monsieur Latry, that was not at least moderately rich in the liver oils of certain fish and the liver fats of sheep, calves, and poultry.

All that is very interesting. But what we want to know is who the villain was who first thought of eating spinach?

If Freezing Doesn't Kill

THE article on page 26 adequately deals with the possible effect on our food supply of a revolutionary new method of freezing fresh meats, fish, and vegetables. The technical reasons for the superiority of the new system also are fully explained.

Perhaps the most amazing detail is the report that fish, frozen by the new method, came to life when thawed out. It is, of course, well known that certain lower forms of life are able to live through the frozen state induced by ordinary slow freezing, but this appears to be the first evidence that animation can be restored to frozen life of a more highly complex character.

The man brought back to life after a period in the frozen solid state is common enough in weird and pseudoscientific fiction. Now that the thing seems to be within the bounds of possibility, a whole new crop of such resuscitations is sure to form the basic plots of more such stories.

While we are about it, we might as well suggest a couple of ideas along these lines to the writers of such stories.

A patient on an ocean liner, for example, who suddenly became ill with anything from smallpox to appendicitis might be thrown into a tank of liquid air. Life, and the progress of the disease as well, might thereby be held in suspension until the ship reached port and the patient could be transferred to the nearest hospital for thawing and proper medical treatment.

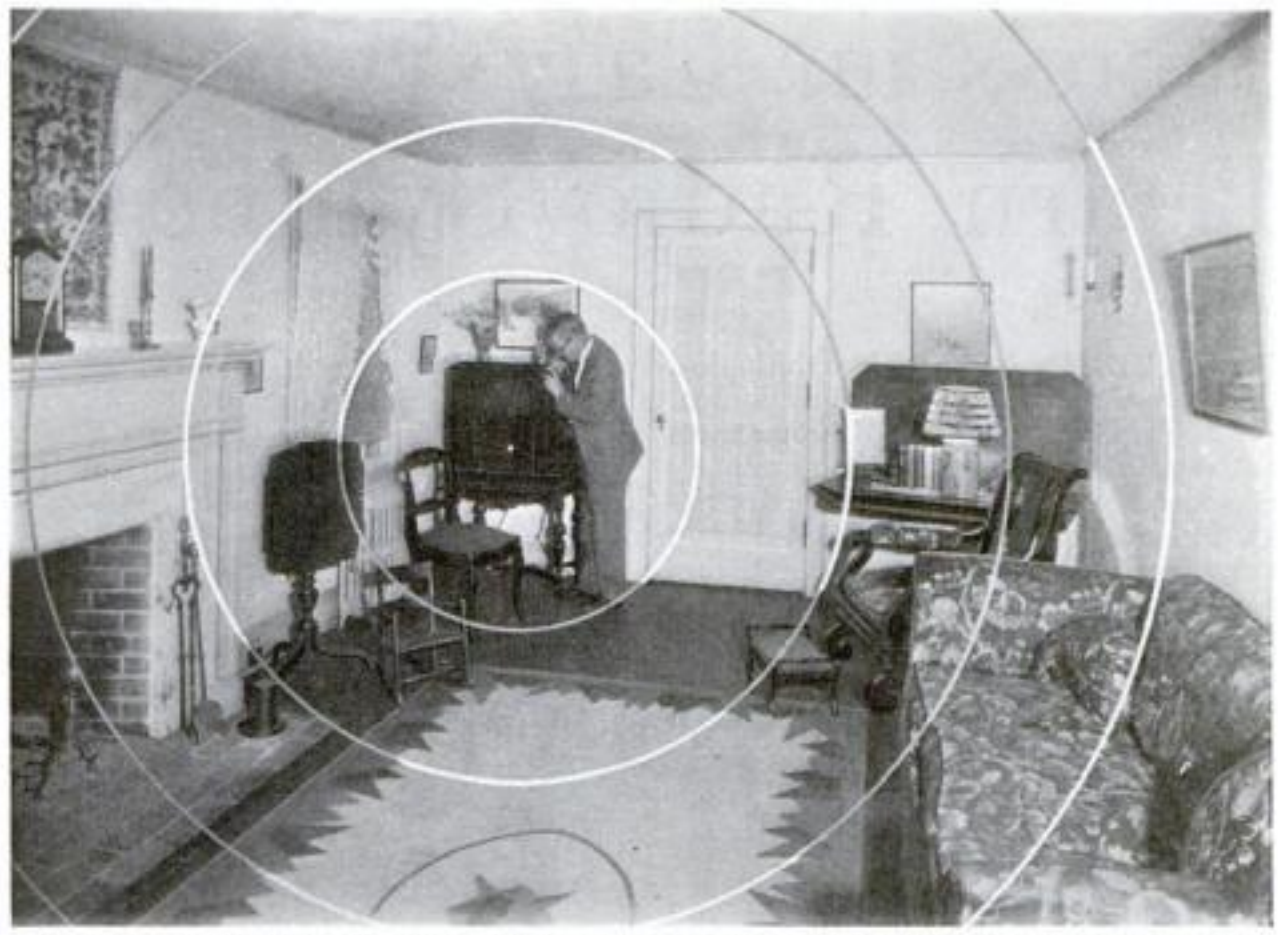
And if we wish to make it weird to the last extreme we might even visualize ocean traffic itself completely revolutionized. Embarking passengers might be slid down a chute into the freezing room, then stacked like so much cordwood for the duration of the voyage. The passenger carrying capacity of any ship would be vastly increased, no food would have to be provided for the passengers and, best of all, seasickness would be completely eliminated!

Why Loudspeaker Foils Experts

Sound waves absorbed by draperies or reflected by walls interfere with tone quality—queer reception kinks now being studied

By

ALFRED P. LANE



Bare walls and absence of heavy draperies and stuffed furniture, with the exception of the couch at right, make this an ideal room in which to install a radio set. The reception would be brilliant.

NO MAGICIAN'S bag of tricks holds mysteries more difficult to solve than those surrounding the action of an ordinary radio loudspeaker. In fact, many competent radio engineers, able to get the finest of results out of the radio-frequency end of a receiver, do not even know how to test a loudspeaker for tone quality.

The difficulty is that a loudspeaker is more than a problem in electrical engineering. Although actuated by electrical impulses, it produces sound, and consequently is beset, to some extent, with the peculiarities surrounding every musical instrument.

Once the radio engineer has calculated the coil specifications of a dynamic speaker so as to apply the electrical power in a most efficient manner, the electrical part of his job is finished. Thereafter he must deal with sound; and engineers are just beginning to learn that sound, although a medium most familiar to all of us, has many queer kinks.

Radio buyers frequently comment on the difference in the sound of a radio set as heard in the dealer's demonstration room and then later on in their own homes. Furthermore, many radio set owners have noticed that identical sets used by friends do not sound like their own. Sometimes they sound better, sometimes worse.

ASSUMING that the radio receiver and the loudspeaker itself actually are producing sound vibrations closely approximating those made in the broadcasting studio—and with the better grades of modern sets this is a fair assumption—differences in tone quality are due to factors over which the set engineer has no control.

When sound is produced by the vibration of any object, such as the diaphragm of the speaker, sound waves travel out in every direction. If they encounter no obstructions they gradually die away. However, in any room, no matter how large, the sound waves eventually encounter the walls, ceiling, floor, and furnishings.

When a sound wave strikes any substance it is absorbed or reflected. If it is absorbed, that marks the end of that portion of the sound wave as far as the listener is concerned, but if it is reflected it starts out again in a different direction. In fact, in a large hall it may be reflected two or three times back and forth with the peculiar echoing effect characteristic of churches and similar auditoriums.

IN A room such as is shown in the picture, the reproduction from any radio set would tend to be brilliant because there is but little in the room to absorb the higher frequencies. In fact, the couch at the right is practically the only piece in the room that would have any very strong effect. The walls are bare and there are no heavy draperies on the windows or doors. If, for example, this same radio set were operated in another room with thick rugs, several pieces of overstuffed furniture, heavy draperies at the windows, and walls covered with cane fiber board and paper, the reproduction would be noticeably different. It would be softer and more mellow.

It is interesting to note that the reproduction from any radio set in any ordinary room seems different from different points in the same room. This is because of the way the sound waves are reflected and absorbed. In addition there is another peculiar effect resulting from reflection. The reflected sound wave may completely neutralize, at some points in the room, similar frequencies coming directly from the loudspeaker. You can make an interesting test of this point.

Late some night when everything is quiet and the radio set has been turned off for a while so that your ears are quite sensitive, turn it on but do not tune in any station. By careful listening you will hear the usual slight A. C. hum. Now slowly move about the room and you will be able to locate several points in the room where the hum from the set cannot be heard. Often these points are very sharply defined. Moving your head out of the quiet zone only six inches or so may often bring back the hum.

It is this peculiar neutralizing effect that makes it so difficult to test loudspeakers. The ideal loudspeaker is one that will give a uniform response at all tone frequencies. No matter how the loudspeaker and recording apparatus is set in any room, these "dead spots" are sure to appear during the test at some point in the frequency range and the loudspeaker gets a black mark for which it really is not to blame. Years ago the solution of this problem was worked out in POPULAR SCIENCE INSTITUTE by moving the loudspeaker continuously and then averaging the intensity of response on the different frequencies. Moving the loudspeaker—or the recording device, which amounts to the same thing—is now recognized by experts as the only way by which a loudspeaker may be fairly tested.

THERE is one other problem connected with the loudspeaker that causes continuous bickering among the members of the family. There usually is some person who wants the set turned on louder than seems necessary to the others. The person who desires the loud reproduction always claims that when the set is turned down the low notes disappear. They do not actually disappear. What happens is that when the whole volume scale is lowered the lack of sensitiveness of the human ear to the lower notes causes them to seem weaker. Engineers have agreed that for true tone reproduction, the volume from the set should equal the volume actually being reproduced in the studio. Which makes it rather difficult for the members of the family who do not like brass bands!

HELPFUL HINTS FOR RADIO FANS

Here's an Easy Way to Learn Radio Symbols

IN STUDYING any subject the logical method is to begin at the beginning. Radio is no exception. If you expect to learn about radio, it is absolutely essential first to study elementary electricity and magnetism. If you are taking up radio merely for relaxation during leisure hours you will get more fun out of it if you understand what you are doing in building the radio set or in attempting other radio experiments.

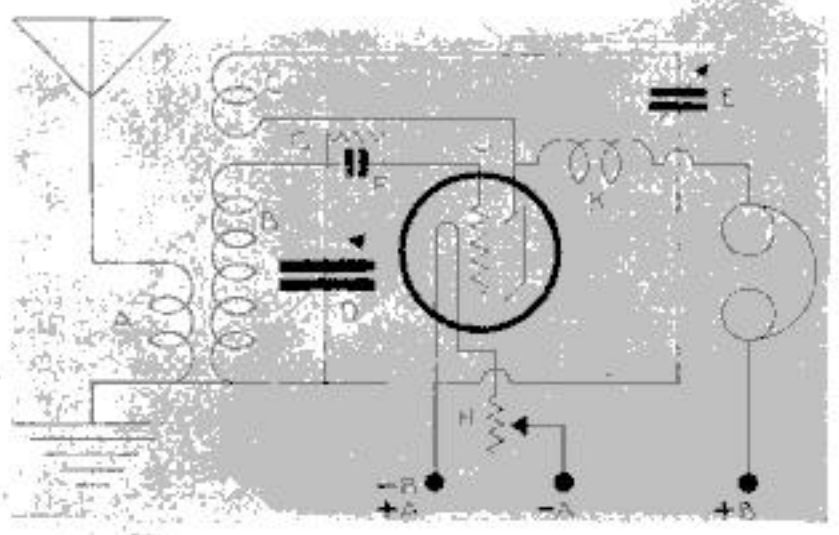
Even if you have an elementary knowledge of electricity and magnetism the study of radio is difficult unless you master the symbols used. Attempting to study radio without knowing what the symbols mean is like trying to travel through Spain without knowing Spanish.

After all, a radio symbol is nothing but a conventionalized and much simplified picture of the apparatus it represents. In a way it is like a child's drawing of a man, where a straight line represents the body and other angular lines represent the arms and legs. On this page is shown all of the symbols you need to understand a simple, modern, one-tube radio set. In each case, the part is pictured with the symbol it represents shown close to it.

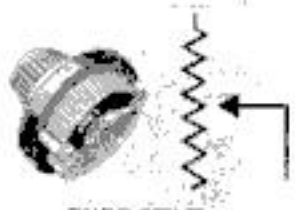
As the logical beginning of a radio circuit is the antenna, this is shown first in its simplest form, and for practical purposes, its best form. It consists of nothing but a horizontal wire insulated at both ends and connected at one end to the antenna binding post of the radio set. The symbol is an inverted triangle bisected by a line which represents the wire to the radio set. As the radio signals flow through a circuit which consists of the antenna and ground, the actual ground connection to a water pipe driven into the earth is shown, of course greatly exaggerated in size, and next to it is the symbol for a ground connection. Note how it is merely a simplified picture of a stick stuck into the ground.

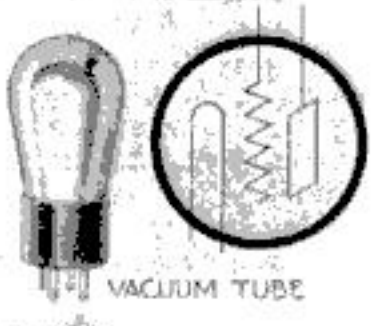
In every radio set there are tuned circuits which almost invariably consist of coils and condensers. A plain coil connected to a variable condenser is shown in the illustration, and next to it is a symbol representing these parts connected in the same way. As the essential feature of a condenser is a group of plates spaced a short distance apart, the symbol for a condenser is two parallel lines drawn close together. An arrow is drawn through these two lines diagonally if the condenser is an adjustable one. If no arrow appears the condenser has a fixed capacity which cannot be varied. If, instead of two parallel lines, one line is straight and the other curved, the curved line indicates the movable plates.

Above, the symbols for antenna and its ground connection. At left, two parallel lines and arrow used to indicate an adjustable condenser.



A theoretical wiring diagram showing how all the symbols explained here are used in radio directions.





At right, the wiggly line that means rheostat with arrowhead for resistance contact. Below it is circle with vacuum tube sign.

At left, the simple conventional symbol that means headphones.

The vacuum tube which, in one form or another, is the vital part of a radio set consists of a glass bulb like an electric light bulb. It is fitted to a special base that has prongs instead of threads. In its simplest form, the type 201A battery tube, there are three metal parts in the tube—a filament surrounded by a wire grid which is in turn placed inside a sheet metal plate.

The conventionalized picture or symbol of the tube, as shown in the illustration, consists of a circle with a line like a hairpin at one side which represents the filament of the tube. Next to it is a wiggly line which represents the grid and at the other side a small square represents the plate.

More complicated forms of tubes, such as the type 227 A. C. heater tube and the type 224 A. C. screen grid tube are represented in the same way with additional lines to represent the other electrodes. In the 227 tube, for example, an extra line represents the cathode and in the 224 the square representing the plate is placed between two extra wiggly lines which represent the screen grid.

Resistances, which in one form or another play an important part in all radio circuits, are represented by zigzag lines. The rheostat, which is illustrated, is nothing but a variable resistance, which means a resistance so arranged that any desired portion of the resistance can be added to the circuit. Next to it you will see the symbol with the zigzag line representing the resistance and the arrowhead representing (Continued on page 135)

A B C's of Radio

BRAGGING about ability to bring in distant stations or to separate close stations from each other is sometimes delightful but always meaningless entertainment.

If two sets that have been laboratory tested and found to be identical are used in different localities, totally different results usually will be obtained. One receiver may bring in one set of stations; the other another set of stations. If the two outfits are shifted about the list of stations heard at each point probably will not change.

How to Obtain Sharp Tuning in Your Set

Selectivity is required to meet modern demands — Several stages needed—Do not tinker with plates until you know by tests exactly what you are doing

By JOHN CARR

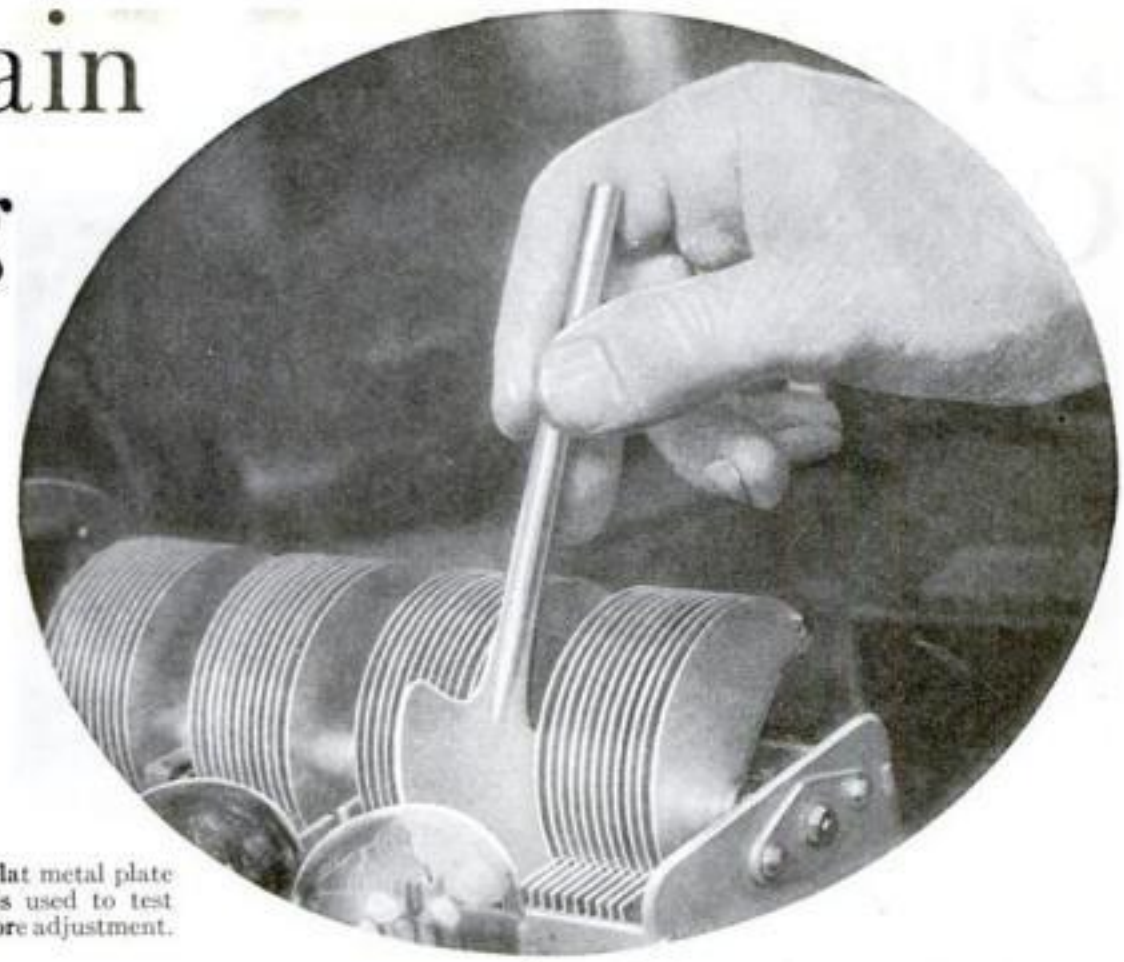


Figure 1. Flat metal plate on handle is used to test tracking before adjustment.

MODERN radio broadcasting demands sharp tuning in a radio receiver. A set designed a few years ago, and which when new gave excellent results, would be almost useless today in many localities.

Sharp tuning, which means the ability to choose between stations broadcasting on waves close to each other, can be obtained only by the cumulative effect of several tuned stages.

It is obvious that the advantage of a multi-stage set, as compared with the single stage, depends entirely on how closely the various stages work with each other. If, for example, there are three stages and the first one tunes too high and the third one too low, there will be no cumulative effect in sharpening the tuning. The result will be about equal response to stations over a relatively wide band of wave lengths.

In modern receiver construction every manufacturer endeavors to have all tuned stages synchronize or "track" exactly alike. Yet it is safe to say that an expert could take about seventy-five percent of the receivers now being sold and by careful adjustment make a definite improvement in the selectivity and volume response.

It is this slight difference in the accuracy of the tracking of the radio-frequency stages which usually accounts for the difference in the performance of two receivers otherwise identical in construction. No matter how carefully the individual parts are built there are tiny variations both in the coils and in the condensers. In the final testing and adjustment at the factory, these slight differences are compensated for as far as it is possible.

Synchronizing or tracking adjustments, which means getting all tuned stages tuned exactly alike, should be done as close to 200 meters or 1,500 kilocycles as possible.

The final adjustment in tracking usually is done by the aid of extra vernier condenser plates attached to each section of the gang condenser. But even if your radio set appears to tune very broadly do not, under any circumstances, monkey with these small vernier plates unless you know exactly what you are doing. Hit or miss adjustment is almost sure to make the tracking worse than it was before.

Before you make any adjustment whatever, the first job is to determine by test which stage is out of track or, in other words, is not tuning to the same point as the other stages. This can be done best by means of a flat metal plate on the end of a short handle as indicated in Figure 1. Tune in some station near the lower end of the dial. Turn the volume control until you get a medium signal and then move the dial a fraction of an inch below the point where the station is heard best.

Now rest the metal plate so that it touches the shaft of the condenser and move it close to a stationary plate. There should be a gain in signal strength and this gain should be approximately the same for each tuned stage if the extra plate is held in approximately the same position.

If you find that the plate reduces the signal strength instead of increasing it, or seems to make no appreciable difference on any one stage, then that stage is already tuning too high and the screw on the vernier condenser should be moved out to cut down the capacity. As a precaution, always note exactly where the screw is before you make any adjustment and note just how you move it so that if you get confused you can set the screw back as it was in the first place.

Moving the extra plate in the manner suggested simply deducts a small amount of capacity from that particular tuned circuit.

If it is possible to get at the tuning coils themselves, and this is usually not possible in any modern fully shielded receiver, a short-circuited loop may be held close to each of the coils in turn as shown in Figure 2 and the effect will be exactly the reverse of the metal plate. A shorted turn will reduce or lower the tuning range of the coil.

It would be possible, therefore, in a set giving free access to the tuning coils, to throw one stage of a perfectly tracked receiver out by means of the extra plate and at the same time pull it back into track again by holding the short-circuited loop to the coil to which the condenser is wired.

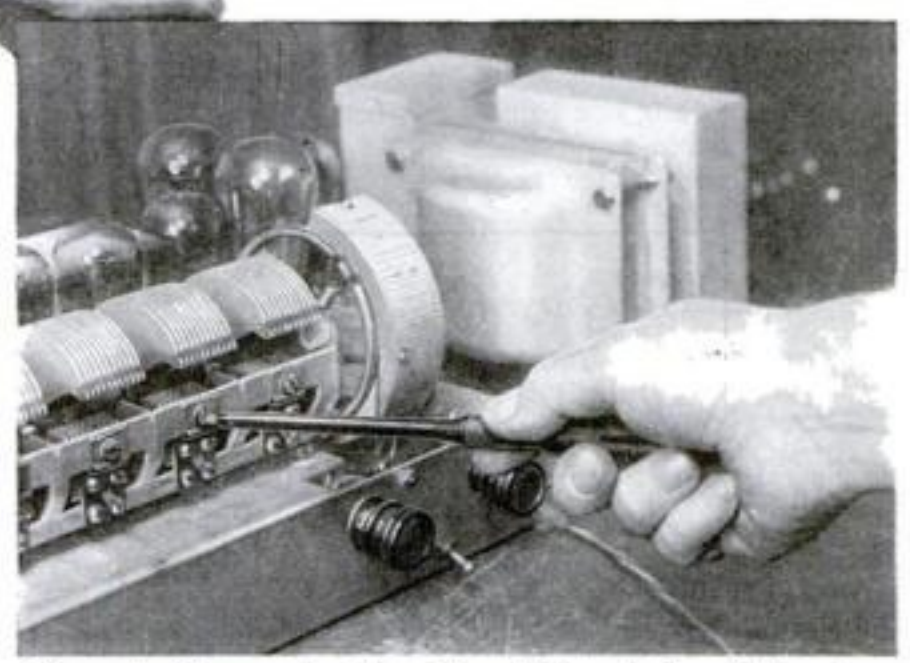


Figure 2. Above, a short-circuited metal loop is brought close to each coil to test it. Below, turning screw in vernier condenser.

Dumb Drivers Cause Most Accidents

By

MARTIN BUNN

"When Reilly got smashed up," Gus said, "it wasn't the fault of his steering gear. He had his eyes on a girl and ran into a pile of dirt in the street."

"HEY, Gus," called Dan Appleyard as he drew up in front of the Model Garage, "do you think it's safe to have a radio receiver in an automobile?"

"Safe? Why not?" asked Gus Wilson, half owner of the garage and the automobile mechanic of the enterprise.

"I hear they bar 'em in some states because they distract the drivers," Appleyard explained.

"Humph!" Gus grunted. "What they ought to do first is pass a law against back-seat drivers! Why, talking to somebody while you drive would bother you worse than a radio. It doesn't take any brains at all, just listening. Seems to me, a radio might even save a fellow from an accident," he suggested after a moment's thought.

"How so?" demanded Appleyard.

"By keeping him from going to sleep," answered Gus. "Speaking of the things that cause accidents," the veteran auto mechanic continued, "you remember a while ago how young Reilly smashed his car and the paper said his steering gear jammed?"

Appleyard nodded.

"Well, it wasn't the steering gear," declared Gus positively. "I was right behind him when it happened and you can take it from me, there wasn't a thing the matter with his steering gear. The trouble was that he had his eyes glued on a girl on the other side of the street, and the first thing he knew he drove right smack into a pile of dirt from a street excavation."

"So that was it, eh!" Appleyard laughed. "But not many accidents happen that way."

"They certainly do," snapped Gus. "Just stop to figure out the real cause of all the accidents you've heard of, and you'll find, nine times out of ten, the driver of at least one of the cars mixed up in the smash was either dumb or careless. And if a dumb driver happens to mix it up with a careless driver—heaven help the other drivers on the same road!

"Remember that horrible smash a few years ago on the state road near Shonk's Mountain? A man—a good careful driver—was coming into town late at night. He was doing about thirty—safe enough. Just as he was rounding a turn another car with four people in it came up behind him doing about fifty, and swung out to pass him. And a third car came around the curve the other way with three people in it, and that car must have been doing sixty. The two cars crashed and seven people got killed.

"The combined speed at which those two cars hit must have been over a hundred miles an hour. Part of the frame of one of the cars swung over and knocked the rear wheel off the car of the fellow who was traveling alone and didn't have anything to do with it.

"I once saw another bonehead make a misplay," went on Gus. "He was traveling along a car track. A trolley car was just ahead of him, and he speeded up to pass the car. He didn't have sense enough to know that he couldn't get past a street excavation which blocked the road a little farther on. As he swung out to pass the obstruction the trolley hit the rear end of his car and swung it square around. It shot straight across the street and smashed into the back of a sedan."

Appleyard laughed. "You make it sound as though even a good driver isn't safe any more."

"Not in cases like those," said Gus, "but they're exceptions. Most times if you keep your eyes open and pay attention to where you're going you can keep out of trouble. Anyhow you're just as safe in the car as you would be walking. Even the sidewalk isn't safe when the dumbbells and careless drivers are around."

"All right," Appleyard decided, "I guess you can put in a radio for me. I'll leave the car sometime next week."

"I'll do it on one condition," said Gus with a smile. "You've got to promise you won't start doing a clog dance when some of that red-hot jazz comes in!"

Gus Says:

IT'S human nature to dodge the hard jobs. That's why so many fellows get along all right when they're on the road and then make a mess of parking or backing out of the garage. If there is anything in the handling of a car that gives you trouble, that's the very thing you ought to practice every day till you get it down pat.

POPULAR SCIENCE HOME WORKSHOP

Articles on Furniture, Models, Toys, Sporting Equipment, and All Forms of Craft Work—Better Shop Methods—The Shipshape Home

A Queen's Sedan Chair Model

By
EDWIN M. LOVE

With its ivory background, colorful designs, golden railings, and crimson lining the sedan chair model forms an attractive decoration for a mantelpiece, bookcase, cabinet, or desk.

Easier to build than any coach yet equally as attractive and colorful—An exquisite gem of ivory, gold, and royal crimson

LAUGHED at, endured, accepted by royalty, and finally adopted for common usage—sedan chairs had their day in the colorful pageantry of the seventeenth and eighteenth centuries. Then, early in the nineteenth, they passed, giving place to the improved coaches that followed the invention of steel springs.

The model illustrated in Fig. 1 is based on a chair used by Marie Leszczynska, wife of Louis XV of France and daughter of the King of Poland, and is typical of the extravagant luxury of the French court on the eve of the Revolution. It makes an unusually beautiful ornament for the home, with its ivory body and decorations in gold, green, brown, pink, and blue, and its lining of rich crimson velvet.

In spite of its attractively ornate decoration, this model is easy to build. On a scale of 1/12 in. to the inch, the chair is only 5⅜ in. high; therefore, leaves and flower petals in the ornamentation are reduced to simple brush strokes, so no great artistry is required. The moldings, of cardboard overlaid with gesso, may be left plain, or may be as intricately carved as the skill and inclination of the builder permit.

Full-size patterns are given in Blueprints Nos. 123 and 124, obtainable from the Blueprint Service Department of POPULAR SCIENCE MONTHLY (see page 103). The first sheet (No. 123) is devoted entirely to the sedan construction; the second sheet (No. 124) contains the details of the chair men and a lady passenger. Directions for making these picturesque figures, for those who desire to add them, will be published in the October issue.

MATERIALS. *From Lumber Dealer:* Pine or hardwood for making the back and floor (as shown in Fig. 8), 2 by 3 by 6 in., S4S (surfaced 4 sides). For top, ¾ by 2½ by 3 in. For pedestal, hardwood 2 by 6 by 6 in.

From Hardware Dealer: For sides and door, sheet aluminum, copper, brass, or zinc, about 1/16 in. thick, 6 by 9 in., or equivalent. (If obtainable, ivory colored celluloid can be used.) Sandpaper, Nos. ½, 0, split 6–0 (garnet). A small quantity of fine pumice stone.

From Art Material Dealer: For molding overlays, 2-ply Bristol board 6 by 12 in., or equivalent; same amount of light pasteboard. Small quantity of four-hour enamel—ivory, white, black, brown, red, yellow, blue, dark green (tints being made by mixing colors with white); clear varnish, turpentine or substitute, pale gold metal leaf, silver (aluminum) metal leaf, and gesso.

From Dry Goods Dealer: For lining, 18 in. of crimson velvet or velveteen ribbon 3 in. wide, or equivalent in costume velvet. For fringe, 6 in. of ¾ in. wide crimson silk ribbon.

Sundry: Household cement, ½-in. No. 20 brads, square jeweler's file for graver, needle and thread, piece of glass for palette, and a 2½-in. wood screw.

Tools: Saw, light hammer, plane, chisel, gouge, fret saw, pliers, sharp knife, soldering outfit, No. 60 drill, and bit large enough to admit a fret saw blade; small flat or half-round file; fine round paintbrush; ⅜-in. flat lettering brush. Round-nosed pliers and jeweler's hack saw are also useful.

CONSTRUCTION. *Sides and Door:* Glue the pattern (in Blueprint No. 123) or a tracing of it on any sheet metal about 1/16 in. thick or ivory colored celluloid (for scaled views see Fig. 5). If brass, zinc, or copper is used, the upper railings may be made separate from the sides and soldered on afterwards. With the celluloid, no background painting will be necessary. Saw out these parts and file to shape (see Fig. 2).

To carve the railings, make a diamond-pointed graver by grind-

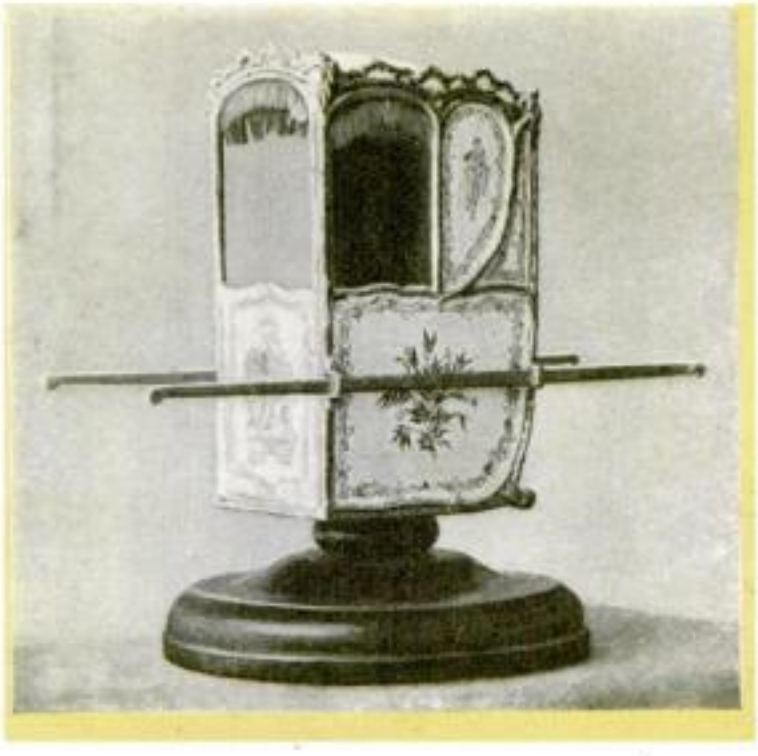


Fig. 1. The model, which is built to a scale of 1/12 in. to the inch, stands about 7⅜ in. in height when it is mounted on a flat pedestal.

ing a piece of ⅛ in. square steel (a needle file will do) diagonally from corner to corner, honing the sides, and fitting it with a wooden handle as in Fig. 7. Hold the tool between the fingers, as shown in Fig. 3, with the handle against the heel of the palm, and outline the leaves of the carving. These will be built up later with gesso.

Back: Cut from a piece of 2 by 3 in. wood (see Fig. 8).

Floor: Make ⅛ by 2½ by 2 in. Rabbet the front edge for a door stop, and glue and nail into the back rabbet under the seat.

Line the back and floor with crimson velvet.

Top: Use ¾ by 2½ by 2⅞ in. hardwood and carve round. Hollow out the ceiling with a gouge.

Assembly: Soak off the paper patterns and scratch both sides of the metal parts with No. ½ sandpaper to give a tooth for the paint and glue. Nail the sides to the back, floor, and top. Line the top with velvet.

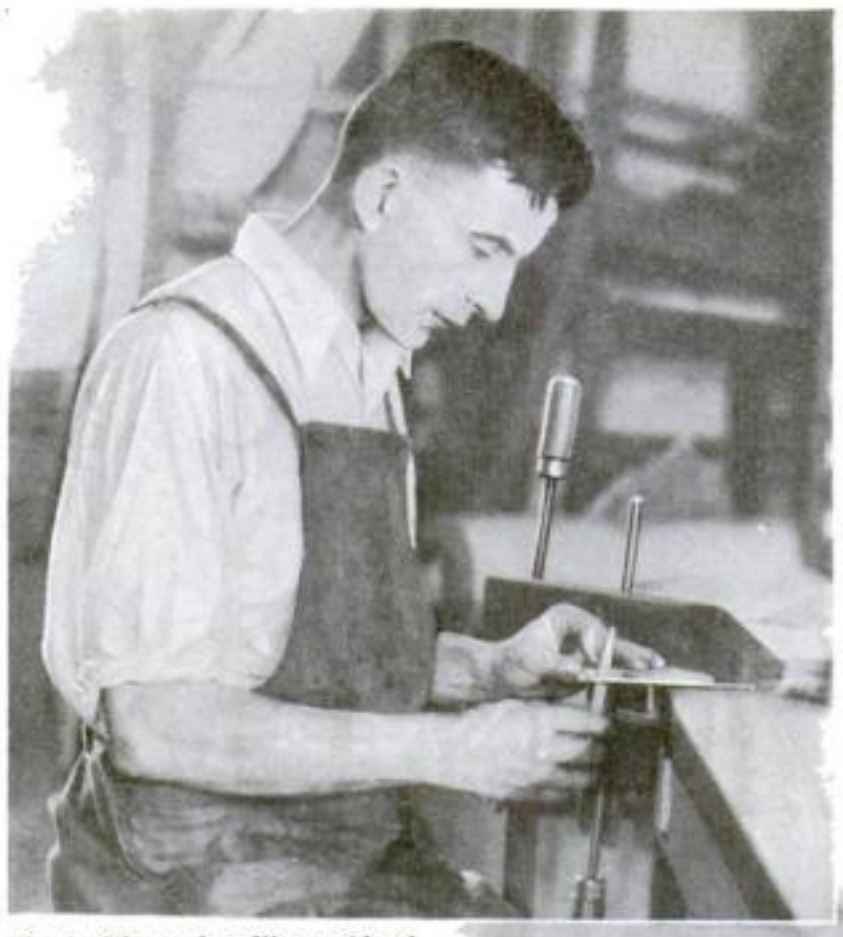


Fig. 2. The author filing a side of the sedan chair to shape. A block with a triangular notch similar to that used in art metal piercing will serve to support the work.

Pole Sockets: Attach front sockets with pins driven from inside and clinched. Nail the rear sockets in place.

Door Hanging: Glue a ½-in. strip of cloth inside the door, letting ¼ in. project, and sew through the holes. Glue and sew the flap to the door post. This allows the door to open one quarter,

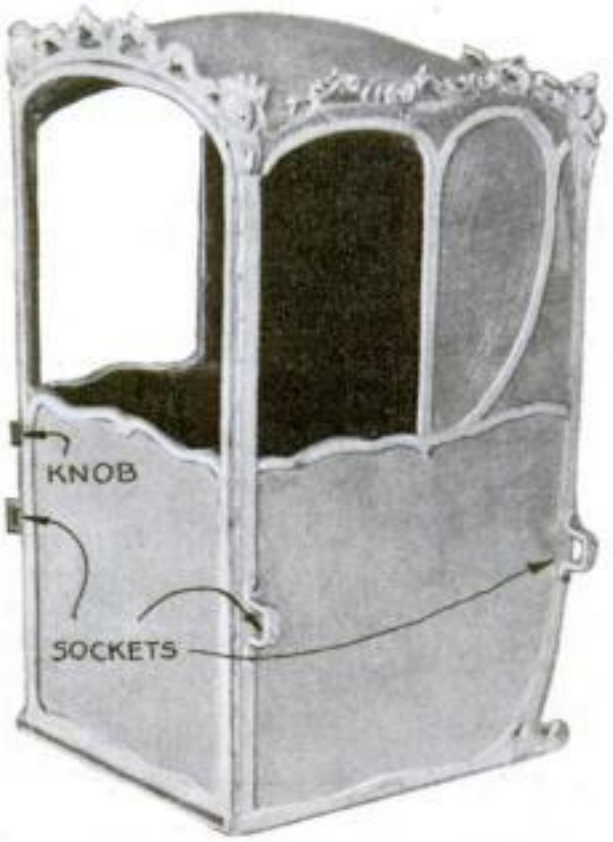


Fig. 4. The sedan chair body assembled with first overlays, sockets, and door knob in place.

which is enough on a model of this size.

Lining: Line the door and sides. When the cement is dry, trim the velvet around the openings; then rub the edges with the glue, and bevel it back with a knife after it has hardened (see Fig. 9).

Seat Cushions and Arm Rests: Make the backing blocks of wood or linoleum, gluing the velvet covers and drawing up the edges behind with thread. Place the arm rests, edges down, with the seat between. Also glue in the front seat pad.

Front and Back Rails: Brad to the top. Fit the front arch to the door, so that the friction will keep the door closed. Tie the corners with thread, and mold wood putty around them. When dry, sketch the carving with pencil and carve as shown in the elevations in Fig. 5 (given full size in Blueprint No. 123).

Lower Back Rail: Using radio bus wire, bend the two halves and lay them in position on a board, where they are soldered. To attach the rail to the model, tie the ends with thread to the side scrolls, and drive a brad in the center beneath, securing the wire with thread. The small leaves and center carving are applied in gesso.

Moldings: The underbands are of 2-ply Bristol board, the outer bands of thin pasteboard. Glue in place, soak with shellac to harden, and trim to shape. The relief leaves are gesso painted on with a small brush, and further carved with a graver and knife when dry. Also paint the spiral bands on the moldings with gesso.

Door Knob: Solder an oval of metal to the head of a ¾-in. brad. Force the brad through a tight hole in the door, and bend horizontally for the inside handle. Round the knob with gesso (see Figs. 4 and 5).

DECORATION. *Background:* Filter ivory four-hour enamel through cloth and apply three or more coats,

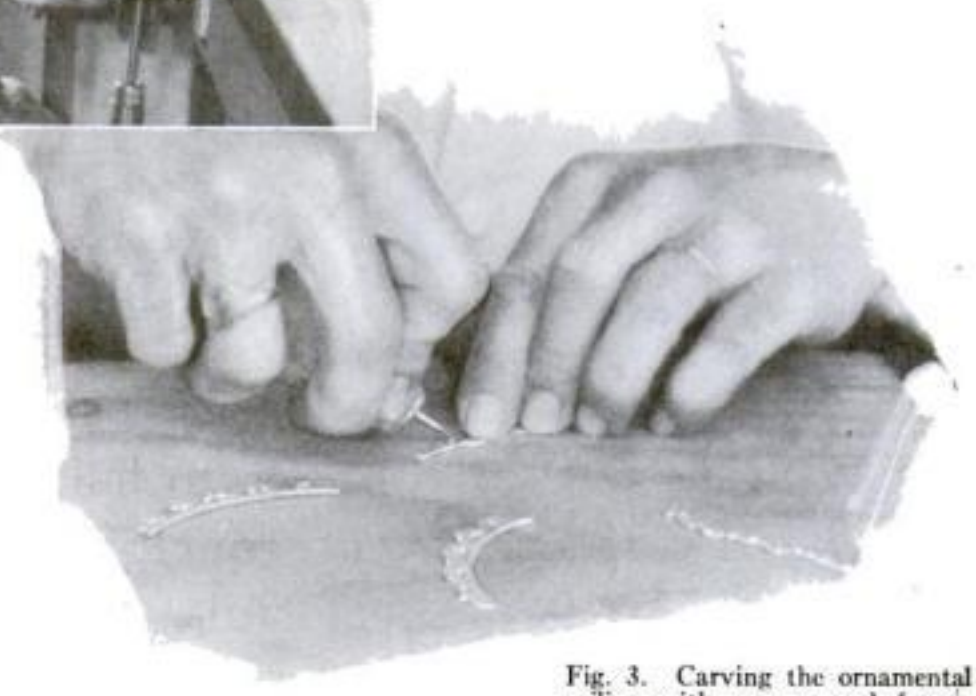


Fig. 3. Carving the ornamental railings with a graver made from a jeweler's file as shown in Fig. 7.

using a ⅜-in. lettering brush. Rub down lightly with split No. 6–0 garnet paper between coats. Rub the final coat dull with pumice and water.

Decorations: Scaled details are shown in Fig. 5. If full-size details in Blueprint No. 123 are used, trace them on tissue, rub the back of the paper with lead

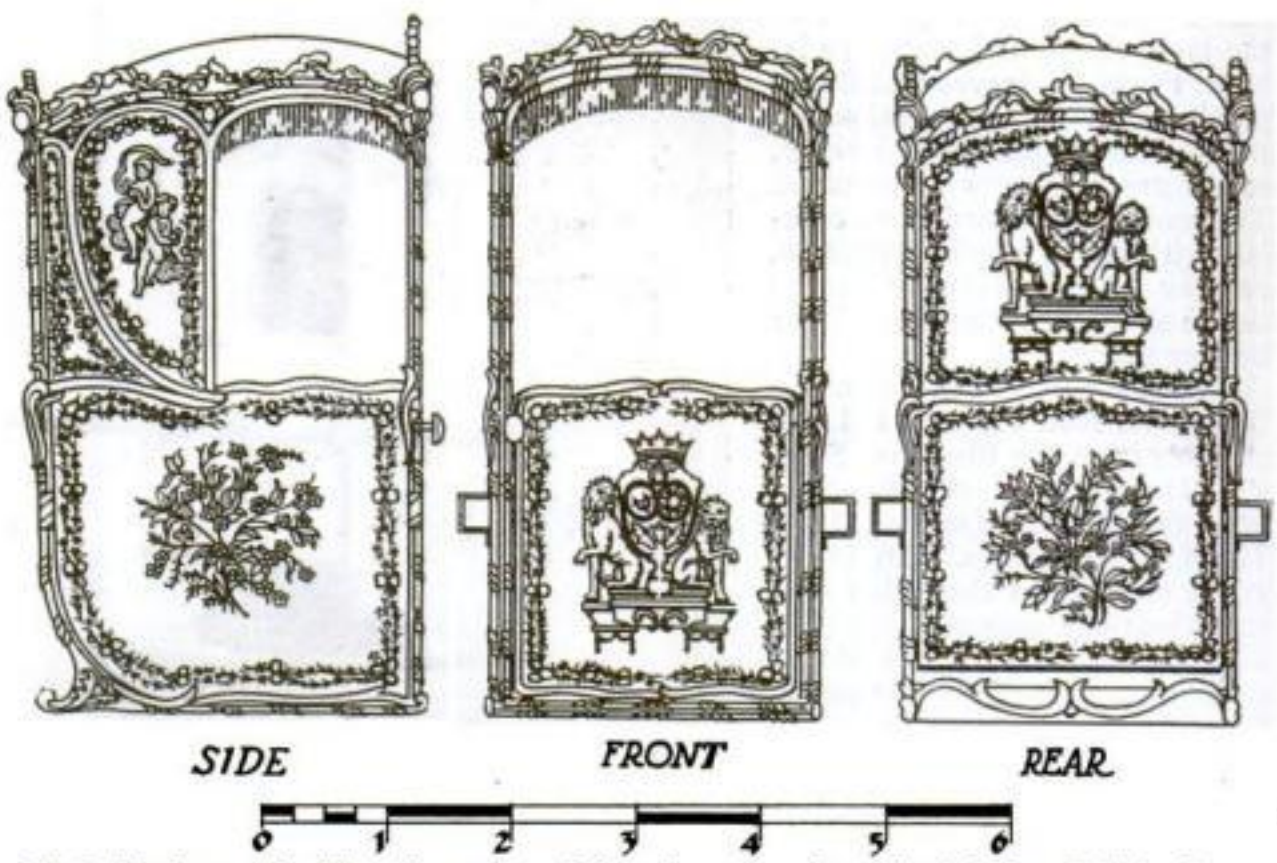


Fig. 5. The front, right side, and rear views of the sedan and a scale reading in inches. Full-size drawings of the chair model together with details of the various overlays are included in Blueprint No. 123.

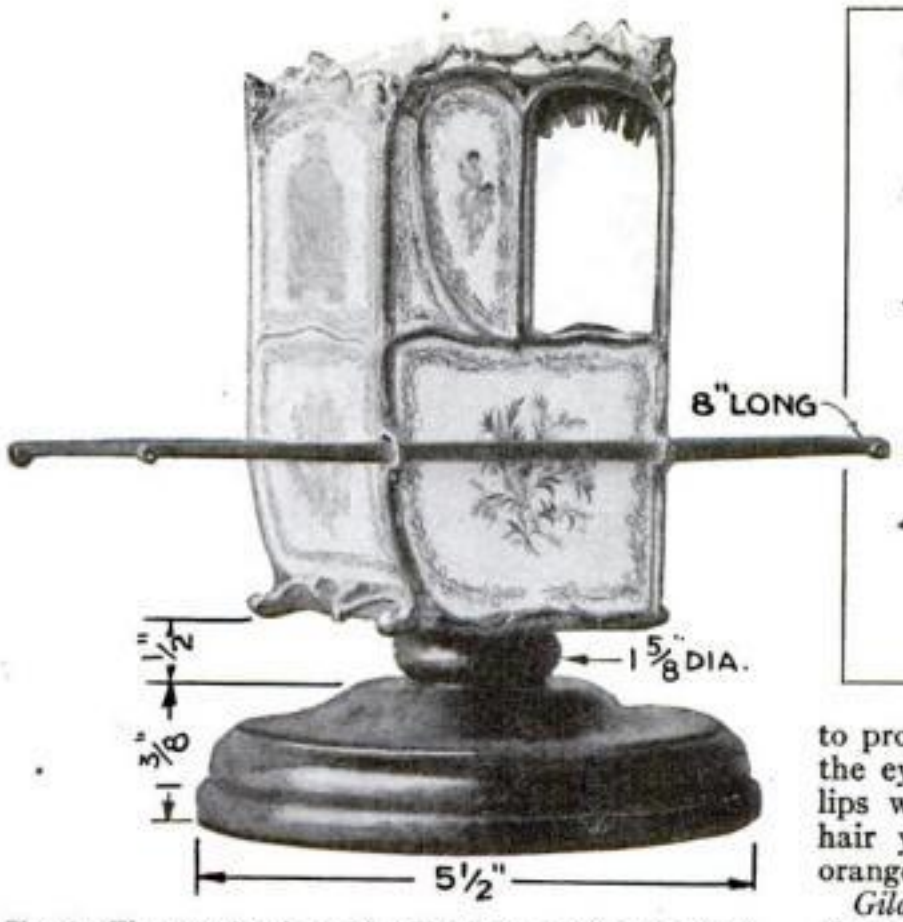


Fig. 6. The completed model. The base, which is made of hardwood and finished black, is attached with a 2½-in. screw.

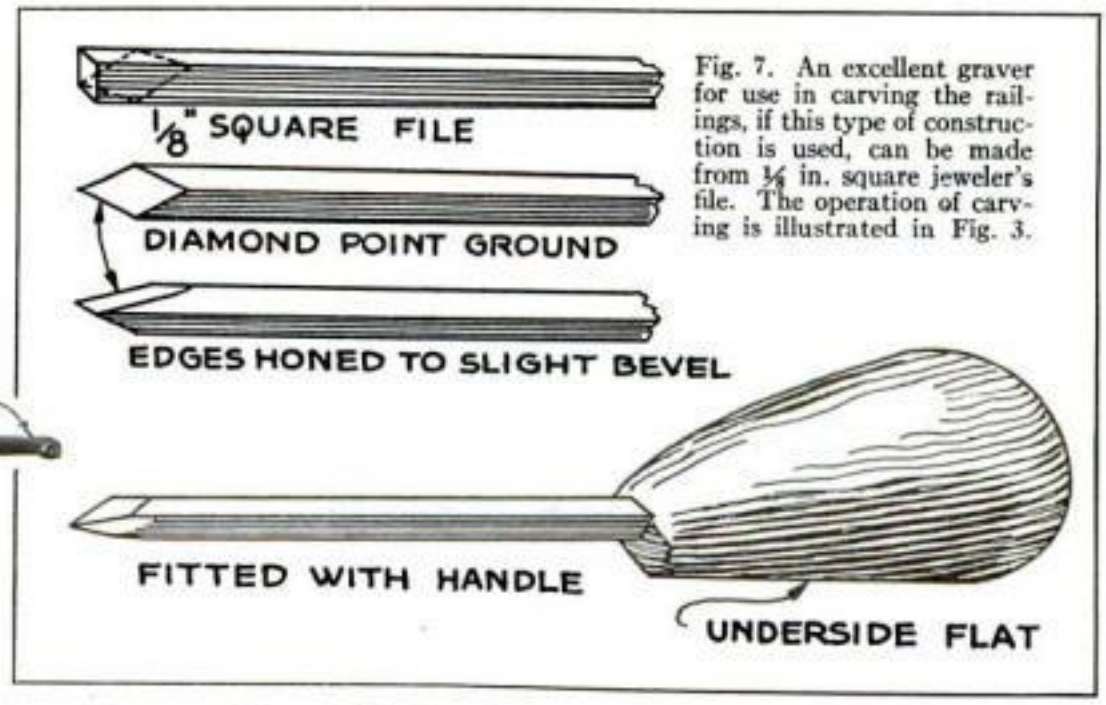


Fig. 7. An excellent graver for use in carving the railings, if this type of construction is used, can be made from ⅛ in. square jeweler's file. The operation of carving is illustrated in Fig. 3.

pencil, and transfer to the work. If it is desired to speed up the process, sketch the ribbons lightly with pencil, and paint the rest of the borders direct. The coats of arms are more quickly traced than copied. Paint the ribbons pink, using a fine brush, and put in the pink blossoms. Spot in the blue flowers with light blue; paint the leaves and stems with medium green. Add accents of color in the form of shaded lines in red, where pink was used, placing these touches on the lower and right edges of petals and leaves, as though the sun were shining on them from a point above and to the left. Accent the blue blossoms with a fairly dark blue, and the leaves with dark green.

The cupids are painted with pink given an orange cast by the addition of a little yellow, and outlined with red shaded off to produce roundness. Fill in the eyes with brown and the lips with red, and make the hair yellow with brown and orange shades.

Gilding: Mix a small quantity of pale gold leaf metal powder with two or three drops of four-hour clear varnish. Do this just before the gilding is to be done, since the fresher the mixture, the easier it is handled and the brighter it will be. Banana oil and similar bronzing liquids must not be used because they would remove the undercoat.

Cleaning Up: Wash with a wet cloth and mild soap.

Fringe: Cut strips of crimson ribbon ⅜ in. wide, leaving the selvage on one edge, and fray out to within 1/16 in. of the selvage for the door, and to ⅛ in. for the windows. Glue the center of the fringe on the door and work toward the ends, pointing the strands downward. On the window headers, glue the ribbon flat, with the fringe projecting out. Wet the strands and fold them into proper hanging position.

Poles: Make these as straight blanks, taper the undersides toward the ends, and fit them to their sockets. Add knobs of wood putty to the ends, and when dry, carve them into scrolls. Round the pole ends for handgrips, tapering back into the square (see Fig. 6). Finish the poles by gilding them.

Base: Turn from hardwood and finish black. Attach to the model with a wood screw through the center entering the bottom of the chair into the seat. See that the model is perpendicular to the base (see Fig. 6).

Slide the two carrying poles in place in the sockets and adjust them so that an equal amount extends out in both front and back

If the fringe around the top does not hang down as it should, wet it slightly and press it into shape with the fingers.

A finishing touch in the form of a felt pad can be added to the bottom of the base, if desired.

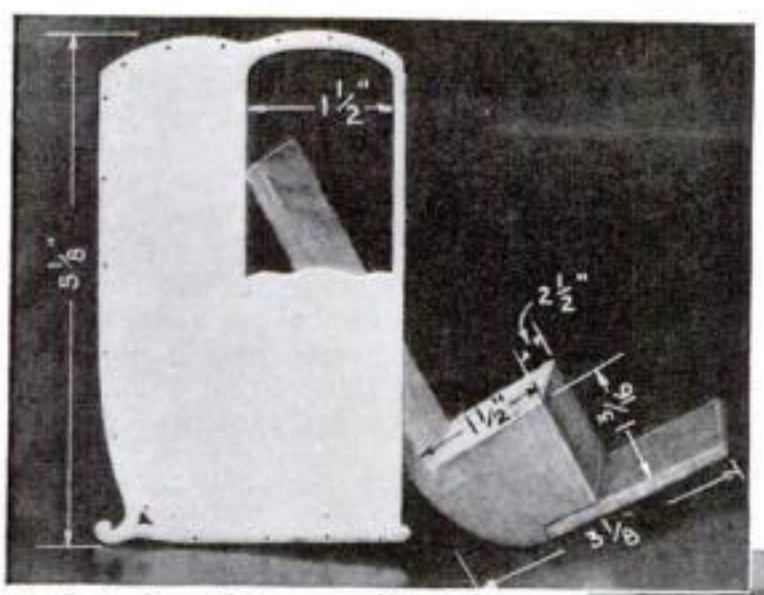


Fig. 8. Back and bottom assembly with one side. If the sides are cut from metal that can be soldered, the railings are cut separately.

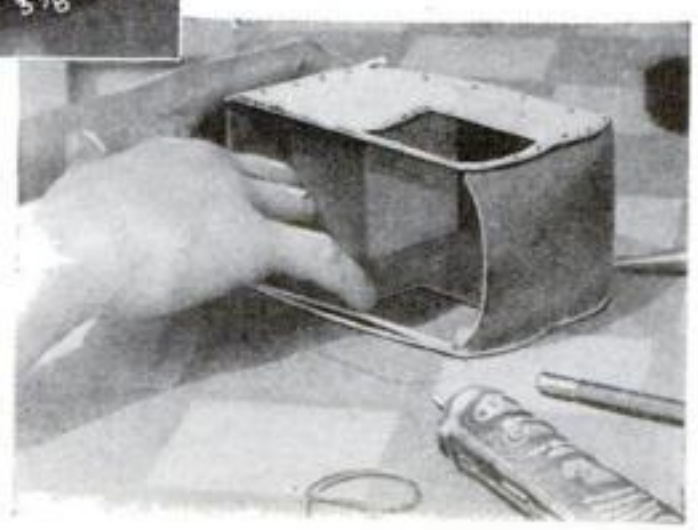


Fig. 9. Lining the sides with crimson velvet ribbon. The door is hinged by using a strip of cloth ½ in. wide for the hinge. The velvet lining will hide the hinge as far as the window, and a coat of red paint will conceal it the rest of the way. The seat cushions and arm rests are made by covering wood or linoleum blocks with crimson velvet.

In the October issue, Mr. Love will tell how to make correctly costumed figures of the sedan's occupant and two husky chair men, as well as a suitable ornamental base.

STAGECOACH MODEL BUILT FROM OUR BLUEPRINTS

AMONG the first readers to report the completion of a stage coach model built with the aid of POPULAR SCIENCE MONTHLY Blueprints Nos. 115, 116, and 117 was A. J. Arnoldy, of Minneiska, Minn. The fidelity with which he followed the plans and the proficiency of his craftsmanship can be seen from the accompanying photograph. Mr. Arnoldy values his model at $175.

An excellent example of what can be done by amateurs along the line of coach model making.

An inveterate model maker, Mr. Arnoldy has constructed two of the ship models designed by Capt. E. A. McCann for this magazine—the Spanish galleon, Blueprint Nos. 46 and 47, and the clipper ship *Sovereign of the Seas*, Blueprints Nos 51, 52, and 53. All these blueprints are listed on page 103.

If you are at all handy with tools, you can

Restring Your Tennis Rackets

By GEORGE H. VAN WALTHER

Fig. 1. Few tools are needed in the process of restringing with new gut.

BEING mainly a process of simple weaving, the problem of restringing a tennis racket falls in the same class of amateur repairs as the recaning of a chair seat. True, it is an art that requires a certain amount of practice, but then no one uses a plane or a saw to the best advantage the first time he tries.

While special tools are convenient, they are not absolutely necessary since anyone owning a home workshop will have most of the essential tools or their equivalent.

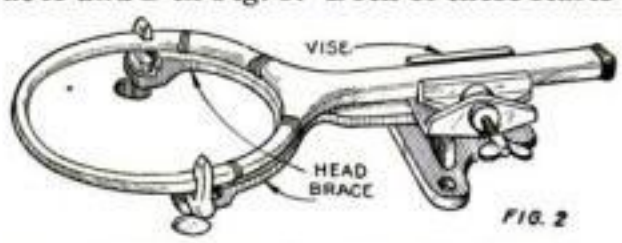
Probably the most important tool is a substantial vise—one similar to the commercial combination vise and head brace shown in Fig. 2, or a good grade of machinist's vise such as is shown in Fig. 1. If an ordinary vise is used, it will be necessary to provide the racket frame with a "billiard" or frame brace, which serves to keep the frame from bending while the tension is applied to the "main" or end-to-end strings and before the "crossings" or cross strings are placed.

Other tools that are needed are: five or six stringer's stop awls (blunt awls used as wedges in the holes to hold the strings taut as the work progresses around the frame), a stringer's dowel, a sharp knife, a pair of flat-nosed pliers, a pair of sharp scissors, and an old glove to protect the hand.

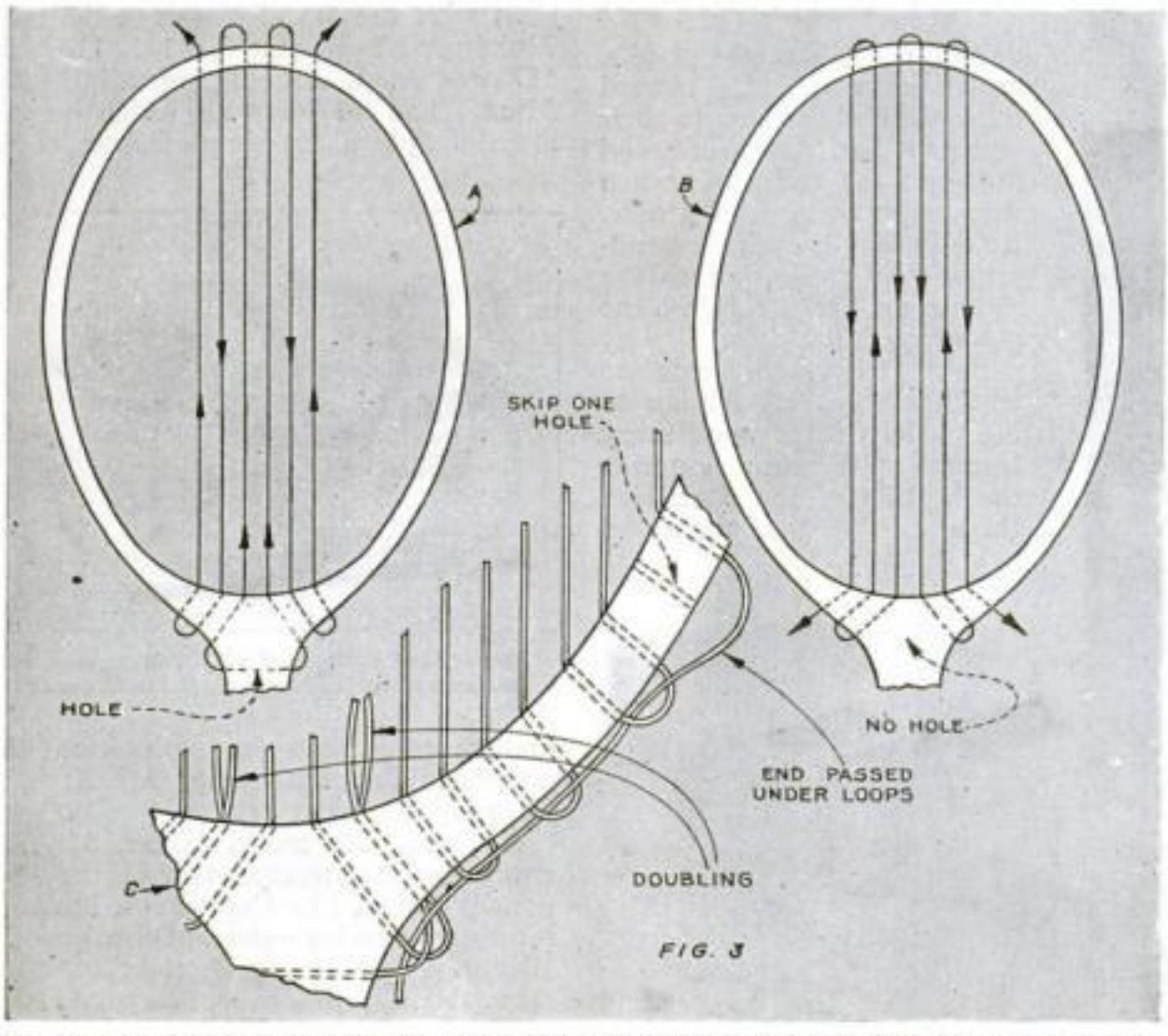
An excellent substitute for the commercial stringer's dowel shown in Fig. 1 is the leather covered portion which forms the grip on the shaft of a golf club. However, the wooden handle of a chisel or mallet can be used.

Before starting the actual work of removing the old strings, study the old stringing closely and copy down the process if it differs in any way from those to be described. This can be done in the manner shown in Figs. 3, 4, and 5. While many methods of stringing are used, the general principle in each case is the same.

The two methods in which the stringing of the "mains" is started are shown at *A* and *B* in Fig. 3. Both of these starts



Commercial vises and combination vises with racket-frame braces can be obtained if desired.



The two methods of starting the main strings if no "doubling" is used (*A* and *B*). The choice depends on the manner in which the frame is drilled. How each end of the main stringing is held (*C*).

are for plain stringing where no double strings, or "doubling" as they are often called, are used. If "doubling" is used, the racket will be of the type having a hole in the throat as shown at *A* and is strung as shown in Fig. 4. No matter what method is followed, however, the strings should advance evenly and should have a uniform tension.

The gut for restringing should be chosen with the utmost care. Try to match as nearly as possible the gut originally used in the racket. Lamb gut is by far the best and is generally used in all of the finer grades of rackets. The gut, which comes in 19- and 21-ft. lengths, can be obtained from your local sporting goods dealer or supply house. If, however, difficulty in obtaining the gut is experienced, send a self-addressed and stamped envelope to the Information Department of POPULAR SCIENCE MONTHLY requesting the name of several manufacturers of gut and restringing supplies.

Before starting the actual stringing, stretch the gut by placing one end of the string in a vise and pulling the other end to remove any slack that may be present.

In starting the "mains," thread a 21-ft. length of gut through the starting hole (see Fig. 3 at *A* and *B* or Fig. 4), pull half of its length through, and place a stopping awl in the hole. Next, thread the gut through the hole directly opposite, apply tension by wrapping the gut around the dowel three or four times to obtain a grip and pulling it tight, and then place an awl in the hole so that the tension will be maintained (see Fig. 1). In the next operation do exactly the same

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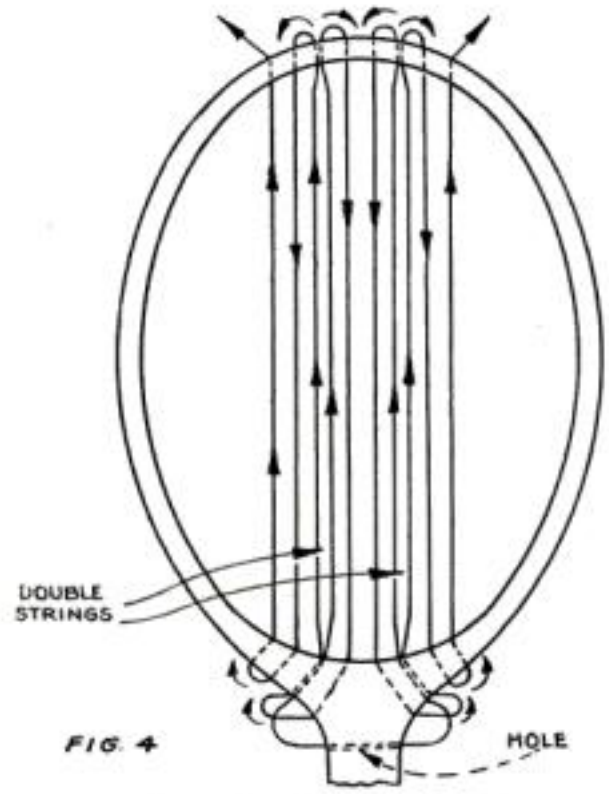
with the other end of the gut on the other half of the racket. Work back and forth in this manner, pulling each string taut and placing an awl in each hole. After three or four strings are in position, the awls that were first placed can be removed. When the last main string on each half is in place, the ends can be fastened by pushing them under the loops in the manner shown at *C*, Fig. 3. Start at the middle again and attempt to tighten each string, following the slack through to each end. A hook made from a heavy nail and furnished with a handle similar to that of a corkscrew will simplify the work greatly.

Another, and perhaps simpler, way for the amateur to string the "mains" is to place the gut loosely at first, effecting the fastenings at both sides, and then to start at one side of the frame and apply the tension and work the slack across the racket to the other side. This process is repeated several times until the required tension is obtained. This method is also used commercially, since a saving is effected by having all of the slack at one end.

In beginning the "crossings," the gut can either be started at the center of the frame as shown in Fig. 1, or at the throat end of the racket. If the latter method is used, the slack comes all at one end.

A 19-ft. length should be started in either case. If the first method is used, the gut is passed through the center holes and the stringing advanced from each side of the center. If the second method is used, the gut is knotted to the "mains" at the lower end and the stringing carried through from that end of the racket.

In stringing the "crossings" the tension can be applied at the first stringing even by the amateur. Stopping awls are used in the same manner as in the stringing of the "mains."



Starting the main strings if "doubling" is used. Note that the throat must have a hole.

The gut is passed over one main string and under the next. If one cross string goes over, under, and over, the strings on either side will go under, over, and under.

The knots at each end of the "crossings" should come on the same side of the frame.

One difficulty in all work with gut is that the material is easily injured and frayed, so care must be taken not to stab it with an awl.

Methods using three 12-ft. lengths of gut are often found in foreign rackets, but the procedure is far too complicated to be included in a short article such as this.

After the racket is completely restrung, space the strings evenly by moving them either to one side or the other with a blunt awl.

The colored strings placed at the ends of the racket are used to maintain the spacing of the cross strings and "doubling." These strings should be applied in the same manner as on the original racket, by wrapping them once around each string and drawing them tight as you proceed across the racket.

The entire stringing should then be given a thin coat of high-grade shellac or the specially prepared shellac sold for this express purpose.

Easy Way to Make Exhibition Poultry Crates

These folding poultry crates can be taken down and are easily transported in an automobile.

By L. M. ROEHL
Assistant Professor of Agricultural Engineering, Cornell University

AT POULTRY shows and county and community fairs, the birds often do not appear to the best advantage because they are exhibited in dry-goods cases or boxes made of rough lumber. Collapsible crates made of poultry netting as illustrated are much better and have the advantage of requiring little space in transit and storage.

The crates consist of three parts—floor, netting, and top. As shown at *A* in the accompanying drawing, the floor is made 22 in. square and consists of two pieces of 11-in. boards 22 in. long, held together by two cleats ⅞ by 3 by 18 in. Sixpenny common nails are driven through the boards and cleats, and clinched. The center of the floor is found by drawing lines diagonally across the square, and a circle 22 in. in diameter is drawn. This is cut out with a keyhole saw, or if a saw is not at hand, the wood may be removed to the line with a drawshave.

To keep the feed and shavings on the floor, a piece of galvanized sheet metal 3 in. wide and 5 ft. 10 in. long is cut as shown at *C* and fastened to the edge of the floor with shingle nails as at *D*.

Poultry netting of ¾-in. mesh is best suited for the crates, as it is stiffer than a larger mesh and keeps birds in adjoining crates from pecking one another.

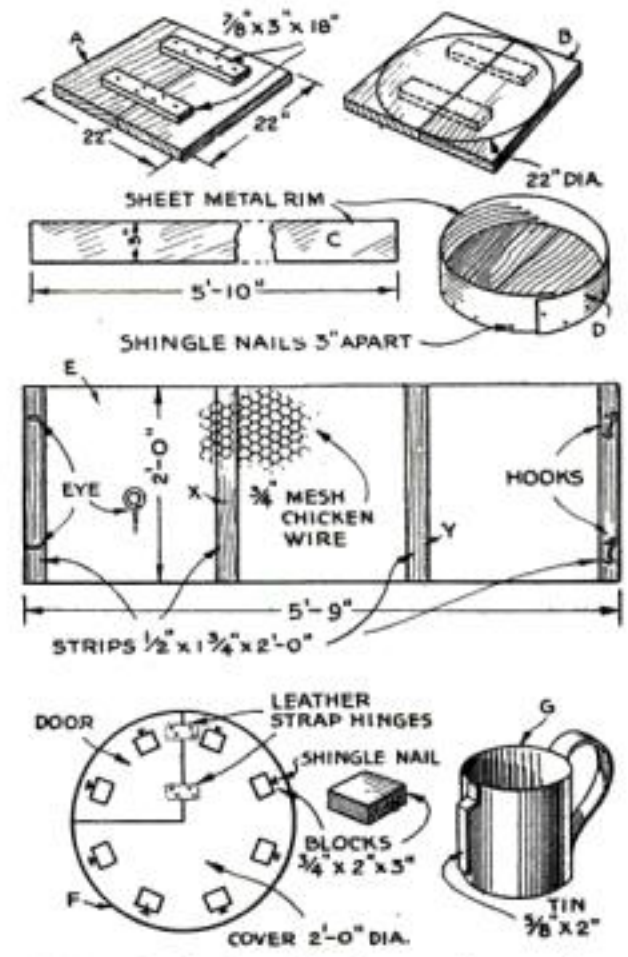
All crates in a show should be of uniform height. A 2-ft. width of netting is a desirable size, as it allows the larger birds to stand erect without touching the top of the crate. A piece 5 ft. 9 in. long, as shown at *E*, is required for each crate. Each end is fastened to a piece of board ½ by 1¾ by 24 in. with poultry netting staples. If 1-in. mesh or larger netting is used, two more cleats of the same size should be placed as shown at *X* and *Y* in detail *E*, to stiffen the wire; common lath may be used. The netting is drawn to a circle, fastened with hooks, and set on the floor inside the sheet-metal rim.

The cover is made of a piece of wall board 24 in. in diameter. A door is provided simply by making two cuts as shown at *F*; it is hinged by using two pieces of leather strap 1 by 3 in. fastened with poultry netting staples or common tacks.

The top is held in place by nailing eight blocks of wood ¾ by 2 by 3 in. as shown in detail *F*. The blocks are evenly spaced around the circle on a line 1 in. from the edge. A shingle nail is driven part way into each block as indicated.

When the top is placed on the netting, the blocks project inside and keep the crate circular, while the protruding nails engage the wire and hold the top firmly in place.

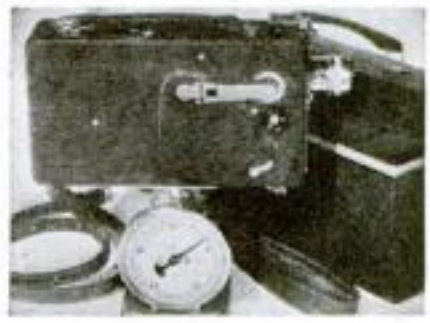
The upper end of a strip of tin ⅝ by 2 in. is soldered to the side of a tin cup near the top as shown at *G*, the whole serving as a detachable water cup.



Dimensioned views of the three main parts that go to make up the collapsible poultry crate.

A Wonderful New Movie Camera

THAT TAKES BLACK AND WHITE, KODACOLOR AND TELEPHOTO MOVIES



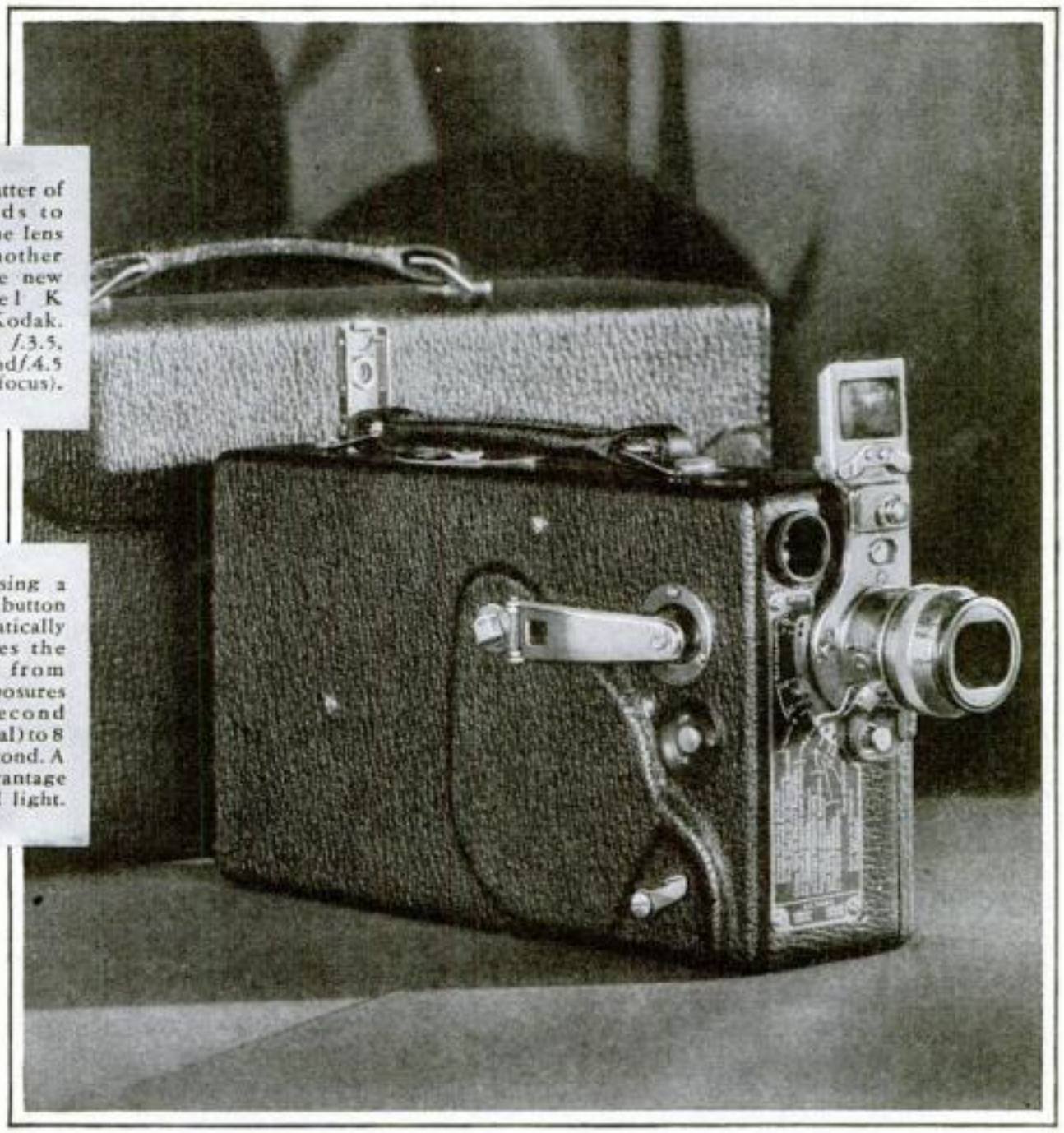
Weighs only 3 lbs. 11½ ozs.

Interchangeable Lenses—

A matter of seconds to slip one lens off, another on, the new Model K Ciné-Kodak. Takes *f*.3.5, *f*.1.9, and *f*.4.5 (long-focus).

Half Speed—

Pressing a handy button automatically reduces the speed from 16 exposures per second (normal) to 8 per second. A big advantage in dull light.



YOU'LL call it marvelous . . . nothing less. This new Ciné-Kodak Model K is all you can ask any home movie camera to be . . . yet hardly larger than a novel.

Two features of the new Model K give it this wide range of use . . . interchangeability of lenses, and half-speed operation at the press of a button.

For ordinary use, the *f*.3.5 lens is completely satisfactory. But interchangeable with the *f*.3.5 is the faster, more versatile, *f*.1.9 lens. The *f*.1.9 is required for Kodacolor, home movies in full color.

Still a third lens, fitting the Model K, is the *f*.4.5 long-focus for telephoto effects.

The half-speed feature gives each picture a longer exposure, a great help in overcoming poor light.

The capacity of the Model K is 100 feet, though 50-foot rolls may be used. Its spring motor is crank-wound.

The Model K is finished in beautiful leathers—black, brown, blue and gray—and is sold in a combination carrying case with room for extra film, filter outfit, and long-focus lens. Equipped with *f*.1.9 lens, it weighs only 3 pounds, 11½ ounces.

Your Ciné-Kodak dealer is now showing, in addition to the Model K, the new Model M Ciné-Kodak. Equipped with *f*.3.5 lens only. The lightest camera taking 100 feet of 16 mm. film. It is finished in black only with carrying case to match.

For Distance—Telephoto Effect

The *f*.4.5 long-focus lens gives a telephoto effect by enlarging the image to three times the usual width and height.

Takes Movies in Full Color—

With the Kodacolor Filter and Kodacolor Film in use, the Ciné-Kodak Model K with *f*.1.9 lens takes Kodacolor . . . home movies in full color.

Model K with *f*.3.5 lens is $110, with case . . . with *f*.1.9 lens, $150 with case. Long-focus lens for telephoto effect and Kodacolor Filter are sold as accessories. Model M, with case, is priced at only $75.

Complete outfits — Ciné-Kodak, Kodascope Projector, and Screen —as low as $143. Eastman Kodak Company, Rochester, New York.

Ciné-Kodak

MODEL K

Helpful Hints for Auto Workers

Tool Box under Hood or Hinged to Dash— Iron Pistons Easily Tested with Magnet

POPULAR SCIENCE MONTHLY awards each month a prize of $10, in addition to regular space rates, for the best idea sent in for motorists. This month's prize goes to Kenneth B. Murray, Sturgis, Mich. (Fig. 4). Contributions are requested from auto mechanics.

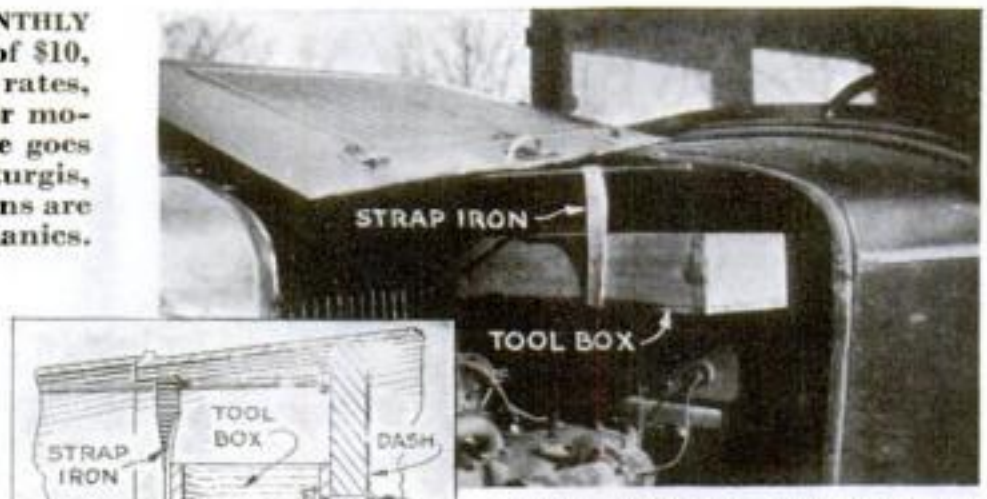


Fig. 1. Tool box fitted under the hood and, left, diagram showing it bolted to the dash and braced with strap iron clamped to radiator rod.

MANY different types of special auto tool boxes have been described in POPULAR SCIENCE MONTHLY. Here are two more. In Fig. 1 is shown a tool box to be fitted under the hood. Modern cars with powerful and compact engines under high hoods make such a tool box possible. In many cars, a still larger tool box would be possible. It should be firmly bolted to the dash and braced with a piece of strap iron clamped to the horizontal rod that keeps the top of the radiator in position.

The tool box shown in Fig. 5 also can be fitted to nearly any car. Because the space arrangement under the cowl makes a shallow tray more practical, a swinging tray of this type will prove useful only for the smaller tools that are most used. The back edge of the tray is hinged to the dash and the latch on the front edge engages with the bead on the lower edge of the instrument panel or a piece of metal bent at right angles.

MAGNET TESTS BEARINGS

IF YOUR motor is fitted with iron pistons, it is possible to test for loose wrist pin or connecting rod bearings by the use of an electromagnet such as is shown in Fig. 2. Of course, it will not work on aluminum alloy pistons. Secure a three-eighth or one-half-inch bolt from fourteen to sixteen inches long. Bend it into a U shape, being sure to have the ends considerably nearer together than the diameter of the cylinder. Place a nut on the threaded end of the bolt and rivet it in place. Now wind the two coils around the ends of the bolt. Use any size wire from twenty-two to twenty-eight and put on as many coils as you can and still keep the outside measurement within the limit of the cylinder diameter. Wind the wire in one direction on one end of the bolt and in the opposite direction on the other end, so as to produce north and south poles.

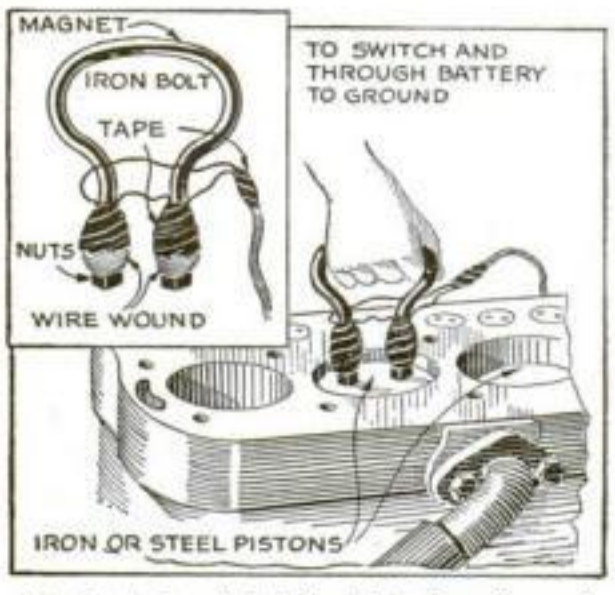


Fig. 2. An iron bolt is bent into horseshoe and wound to form a magnet to test iron pistons.

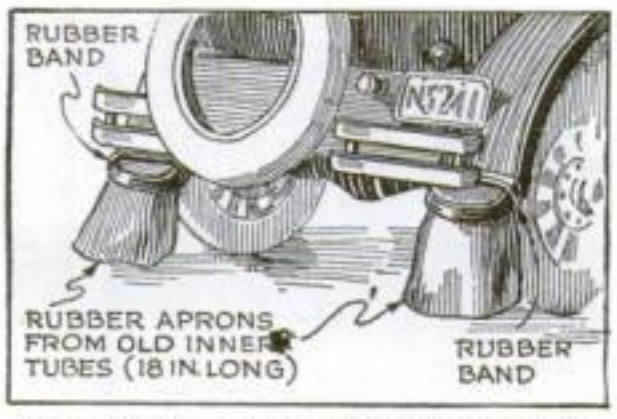


Fig. 3. Fender aprons to keep off mud and tar can be made from old automobile inner tubes.

FENDER APRONS

A DISCARDED inner tube supplies all the material needed for fender aprons (Fig. 3) that will prove especially useful to prevent mud, tar, or slush from splashing all over the body. Cut a pair of heavy rubber bands from the tube, then split a portion of the tube lengthwise and cut the two aprons. The upper edge of the aprons should be sewed with pieces of wire to the rubber bands so that they will be held in place when the bands are snapped over the lower ends of the fenders.

SPEED EASY TO READ

THE miles-per-hour figures on the speedometer can be read much more easily if a special lens is used as shown in Fig. 4. Remove the small bull's-eye lens from the pocket type of flashlight. One side of this type of lens is flat and the other convex. One drop of Canada balsam cement should be placed on the flat side of the lens and spread evenly over the surface. Then the lens should be pressed to the cover glass of the speedometer and held in place till the cement dries. Canada balsam cement is used by lens makers to cement together the sections of lenses and can be obtained from any dealer in optical goods.

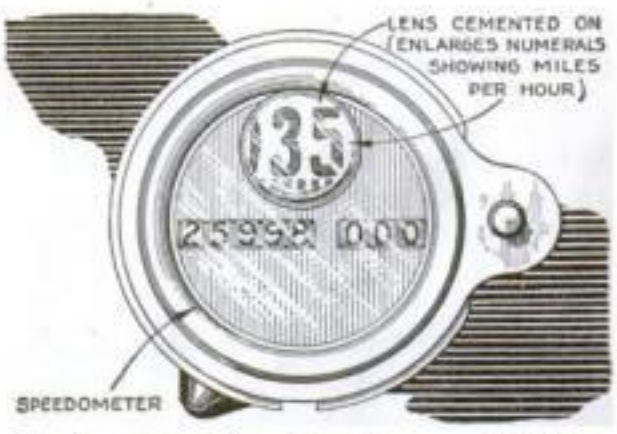


Fig. 4. A bull's-eye lens from a flashlight, fitted over speedometer, magnifies numbers.

Drivers who are annoyed by comments from passengers on the back seat whenever the speedometer registers beyond a certain figure will find that this extra lens cures the trouble by cutting off the view of the speed figures to everyone except the driver.

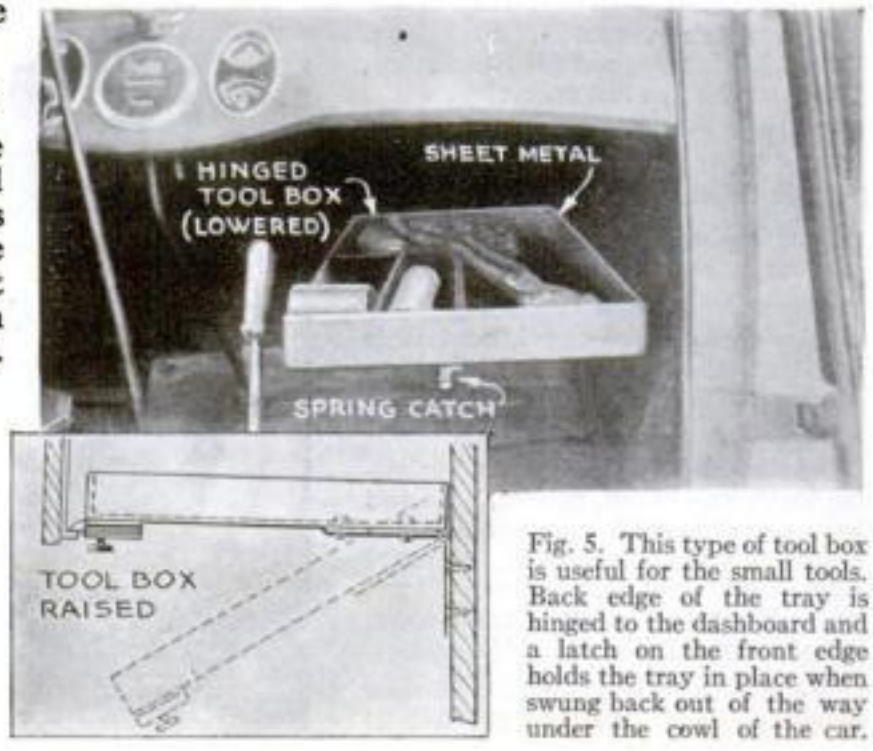


Fig. 5. This type of tool box is useful for the small tools. Back edge of the tray is hinged to the dashboard and a latch on the front edge holds the tray in place when swung back out of the way under the cowl of the car.

Your oil—was it made to fit

your engine or to fit some crude oil?

Here are two men.  Each one is going to make an oil which he will offer for your engine. The first man starts with some particular crude oil. He must pick the process and use the equipment best designed to refine that *crude.*  But, since the refining process often *changes* the properties present in the crude and also changes their proportion, this man may get a deficient oil even from a high grade crude . . . The other man begins with the needs of *your engine,*  not with a particular crude. He knows that your engine needs certain properties in an oil —and in certain definite proportions: 1. CARBON  CONTROL—to keep down hard carbon deposits. 2. HEAT RESISTANCE—to make your oil last longer. 3. OILY CHARACTER—to protect moving

ys from wear. 4. OXIDATION CONTROL—to prevent gumming and sticking of exhaust valves, logging of oiling system.  Too much of one property, not enough of another,

ld make a badly-proportioned oil instead of a full-duty oil. He chooses processes needed to develop

e properties in exactly the right proportions.  He chooses crudes which contain them. When

: oil is finished it is MADE for your engine . . . Of the two resulting oils, you'd doubtless choose the ne that was MADE *for your engine.* When you choose Mobiloil, you choose that kind of oil. The makers of Mobiloil  know that engine study, not crude oil, is the soundest scientific basis for determining how a full-duty oil can be made. The most thorough lubrication study of gasoline engines ever made has been conducted by the Mobiloil technical staff.  That is where the making of Mobiloil starts. Mobiloil processes, crudes and equipment are all dictated by the *needs of your engine,* not by the requirements of some particular crude. And that's why Mobiloil in your crankcase will keep your engine young for many thousands of miles. Mobiloil is MADE by the Vacuum Oil Company.

LOOK FOR THIS SIGN

How to Cut Your Own Moldings

By using a small motor-driven shaper it is easy to give a professional look to the furniture you build—for example, a Colonial gate leg table

By WILLIAM W. KLENKE

Author of *Art and Education in Wood Turning* and *Joints and How They Are Made*

BEFORE the introduction of portable motorized woodworking machines, it was only at the mill or cabinetmaker's shop that one could have special moldings worked out to design, and this, of course, was expensive. Now, however, there are a number of small shapers on the market, as well as molding cutting attachments for use with small circular saws, so that the amateur need no longer be dependent upon an outside source for the special moldings he needs for his furniture or other woodworking projects.

The shaper illustrated in Figs. 2, 3, and 4 has ample capacity for cutting straight strips of moldings or for running molded edges on all sorts of curved pieces. The motor, which drives the cutter directly, is clamped securely in place by a quick turn of the adjusting mechanism; and the depth of the cut is regulated by screwing the motor itself in either direction. Furthermore, the motor can be tilted at any angle and locked by means of a quadrant accurately divided into degrees (see Fig. 4). The straight fence or guide is employed for all straight work, and a special adjustment is used for molding curved parts.

This particular machine is made in two sizes. The smaller size (Fig. 5) can be used without the table by holding the motor in the hand; this is an especially useful expedient on jobs that are too large to take to the machine or for molding various kinds of curved work. This type is also valuable for repair jobs.

The cutters must be kept sharp in order to make a smooth, clean molding. When sharpening them, make certain that all blades of the cutters are brought in line Because of the need for extreme accuracy in this respect, it is desirable to make use of a special shaper-cutter sharpening arrangement, which is designed to take care of this point automatically.

When using a shaper of this type in connection with the table, be sure to keep the guard over the cutters, and never hold the fingers over the throat while the motor is running. There is no danger if these simple precautions are observed, although all high-speed machinery must be treated with respect.

This being the last article of my series on small woodworking machines, I have chosen for my project the old, but always popular and beautiful, Colonial gate leg table because this entire piece can be made by machinery. In place of the large table so often seen, I have designed a smaller size, which can be used as a hall console with the leaves dropped or with the top up for serving afternoon tea or an informal luncheon.

The delicate, graceful proportions of the turned legs make it advisable to use a rather hard wood so as to give strength. The table illustrated in Fig. 1 is made of quarter-sawed white oak and stained a fumed oak finish. Mahogany, maple, and walnut are all good to use for this project

Fig. 1. This diminutive Colonial gate leg table, which can be made entirely by machine, serves admirably as a hall console or a tea table.

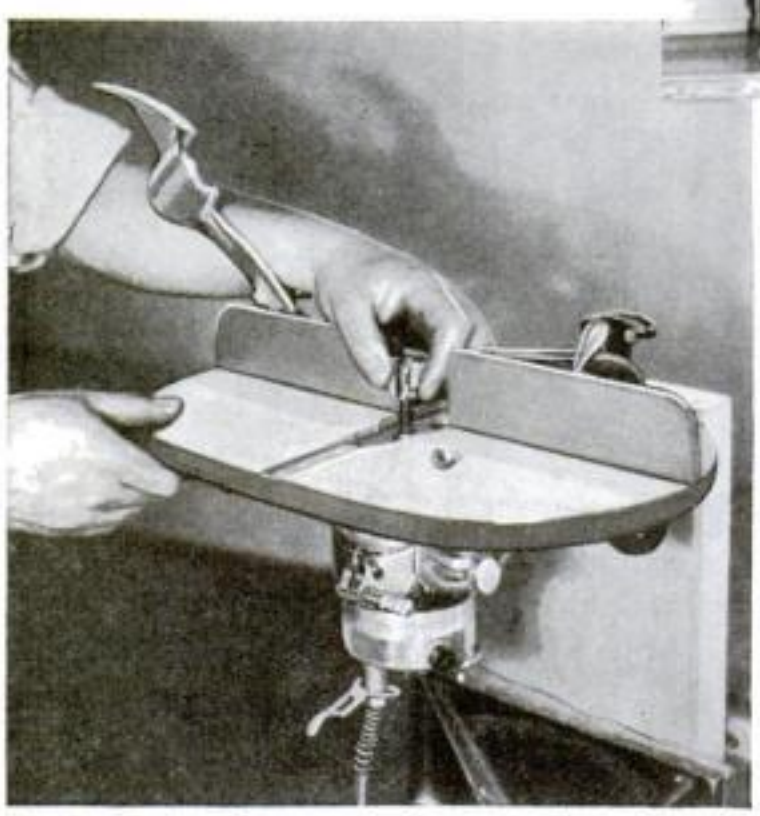


Fig. 2. Putting the cutter head on a small portable table shaper. Note the metal cutter guard swung up out of the way. The shaper is mounted on a board which is held in a vise.

Fig. 3. Cutting a molding with a portable table shaper. Pushing the work through automatically lifts the cutter guard just enough to admit the stock.

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for the top with care, obtaining a piece with an even grain.

Step No. 1—The Stock. Carefully plane all pieces on the jointer, making a working face and edge (P.S.M., Jan. '30, p. 78). Then rip to width on the circular saw (P.S.M., Nov. '29, p. 88), allowing about 1/16 in. for the final planing. The truer you make the pieces for the legs and rails, the easier it will be to do the turning.

Step No. 2—Turning. Square a line around the various pieces so as to mark off the portions that are to remain square. Carefully turn the legs and rails to the design shown and thoroughly sandpaper them while in the lathe (P.S.M., Mar. '30, p. 78).

Step No. 3—Joints. Make mortise and tenon joints for the leg and rail construction, cutting the mortises first and fitting the tenons to them. The holes for the mortises can be bored out by machine, using a chuck in the headstock of the lathe and forcing the work into the bit with the tailstock adjustment (P.S.M., Sept. '29, p. 108). The tenons are then cut on the circular saw (P.S.M., Nov. '29, p. 88).

Step No. 4—Sanding. Use a portable sander with the table adjustment in place for cleaning up the flat rails (P.S.M., Apr. '30, p. 75).

Step No. 5—The Top. The side leaves or flaps should be made of good, dry, straight stock cut from the heart of the tree; or of narrow pieces glued together to insure a flat, true surface. Clean up these toppieces with your portable sander; then lay out the circular outline. Cut out the curve on the band saw (P.S.M., Feb. '30, p. 86). Run the rule joint and outside edge on the shaper or on whatever special molding cutting device you have

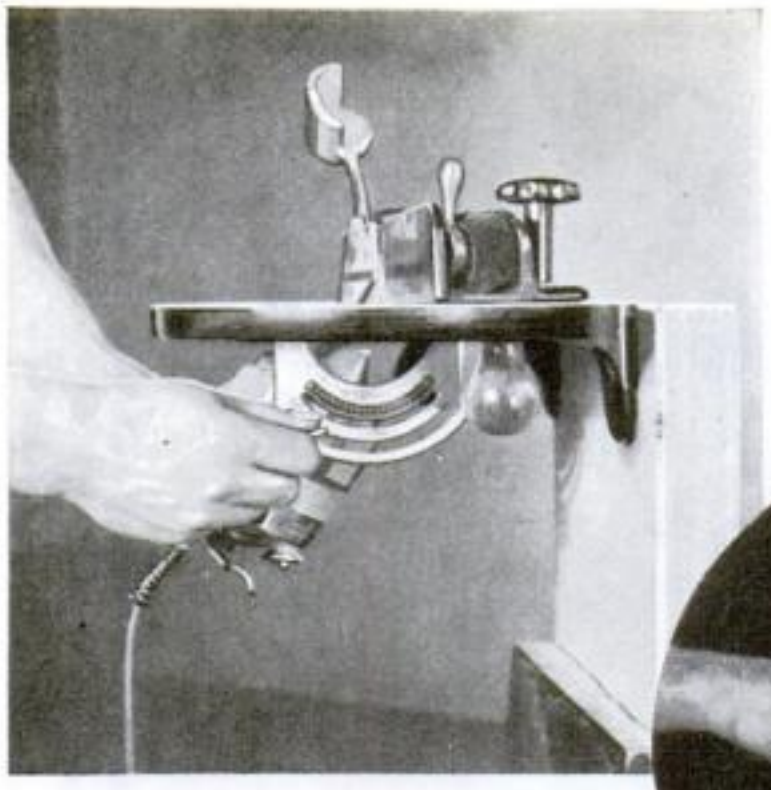

Fig. 4. Side view of a portable table shaper showing the quadrant used in setting the cutter at an angle. The entire motor and cutter unit is tilted on the quadrant.

Fig. 5. The hand type of portable sander being used to put a molding on a curved piece of stock. The motor is controlled by a convenient tumbler switch on the top.

on your circular saw. Care must be taken to make this rule joint a quarter of a perfect circle; otherwise the piece cannot be hinged properly.

Step No. 6—Assembly. Put the entire framework together between clamps *but without glue*—a trial fitting. Now mark all companion pieces as Nos. 1 and 1, 2 and 2, etc., so as to be sure of getting all pieces together correctly when gluing. The actual gluing must be done in three separate operations. The two gates should be glued together first; when the glue has set, assemble the two long sides, working these gates in place at the same time. Allow this much of the table to set between clamps undisturbed. Now glue up the two short ends. Carefully square and line up all parts. Throw a little fine sawdust over the glue that oozes out of the joint; the sawdust will absorb the moisture in the glue, making it easy to peel off the excess with a chisel. The three parts of the top are first hinged together (see the drawing in Fig. 6); then the top is fastened to the framework.

Step No. 7—Final Cleaning Up. Thoroughly sandpaper all parts with Nos. 0, 00, and 000 sandpaper for the fine grained woods. No. 00 sandpaper will be fine enough on oak and similar material. Slightly round all sharp corners.

Step No. 8—Finishing. In preceding articles of this series, I have explained various kinds of finish suitable for a piece of this kind. However, as the original table was finished in fumed oak, I shall now describe briefly how to obtain this type of finish *on oak*.

Commercially, the furniture is placed in an air-tight room in which a pail of strong ammonia is set. The fumes given off by the ammonia react chemically with the tannic acid found in oak, giving to the oak a beautiful seal-brown color. Unless you have the proper facilities for handling the work in this way, it is far better to apply a ready-mixed fumed-oak stain, which will produce a close imitation of the real fumed oak color. After the stain has dried for at least eight hours, apply a thin coat of white shellac so as to make the raised fibers brittle; then sandpaper the work smooth with No. 00 sandpaper. Continue with another coat of shellac, which should be rubbed down gently; then apply a coat of prepared wax to give the soft luster that is typical of this type of finish.

Information on finishing mahogany is given in P.S.M., Nov. '29, p. 90 and Jan. '30, p. 80; maple in P.S.M., Feb. '30, p. 88; and walnut in P.S.M., Mar. '30, p. 80.

This is the last of a series of fourteen articles which began in the August, 1929, issue. Other articles on the same general subject are scheduled for early publication, the first being an unusually ingenious method of driving small power tools.

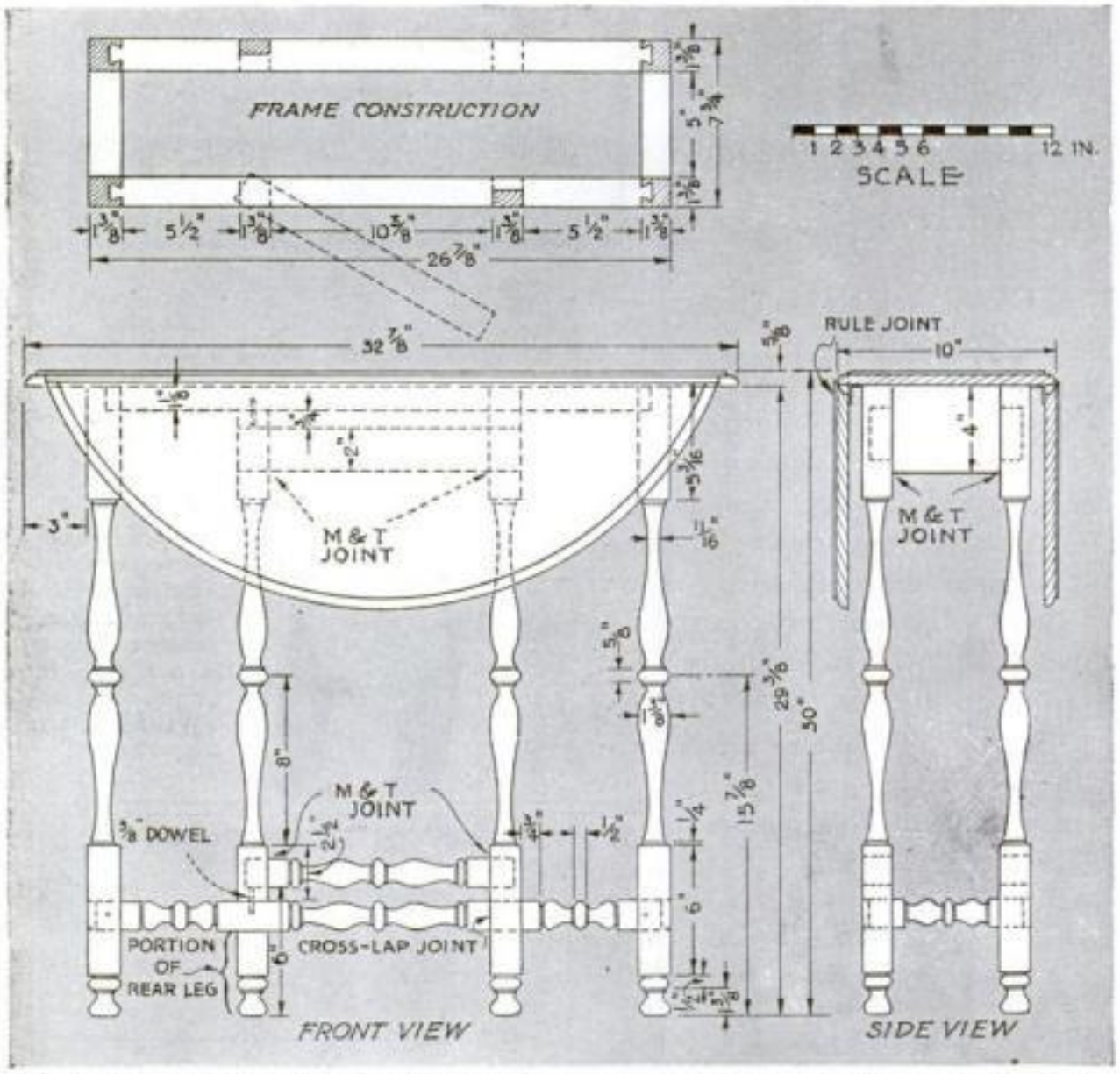

Fig. 6. Assembled views of the small Colonial gate leg table and a plan showing the construction of the frame. Quarter-sawed white oak, mahogany, birch, maple, or walnut may be used in the construction.

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Lapping—Best of Shop Finishes

Hints on fitting gears, bearings, and spindles to reduce friction

By HECTOR J. CHAMBERLAND

Lapping is used not only in finishing gages but in fitting bearings, spindles, bushings, sleeves, and all types of metal gearing.

FACED with the demand for higher standards of finish than even that given by precision grinding, the men in up-to-date machine shops and tool rooms are having to study closely the art of lapping. They must know the best and most economical ways to obtain that microscopically exact finish which comes from taking an already carefully ground surface and polishing it with the finest of abrasive compounds.

Many lapping problems arise because it is now often necessary to lap not only plug, ring, and snap gages, but bearings of the solid and split type, bushings and sleeves, gears, worms, and a variety of similar work.

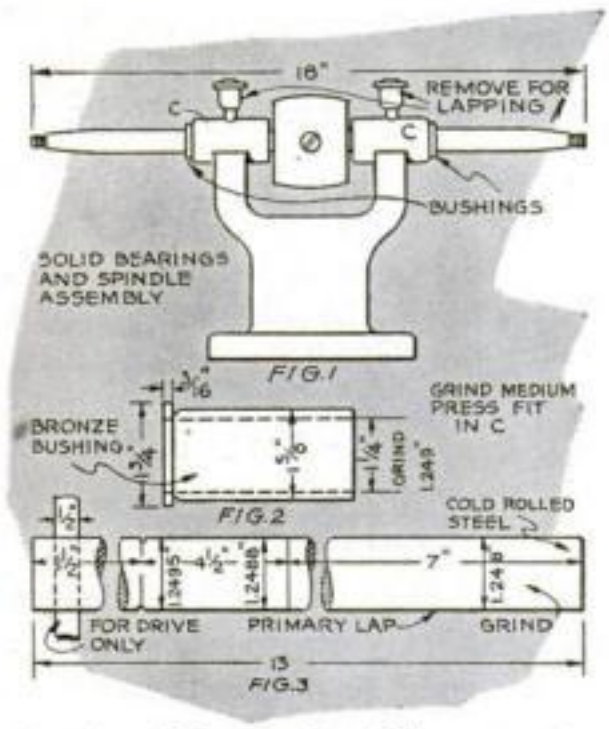
The importance of lapping arises from the fact that a commercial grinding job under the microscope appears as an area of hills and ridges. Lapping removes the ridges and allows the surfaces to move against each other with the least possible friction, thereby preventing the oil film from becoming ruptured (see Fig. 7).

The secret of successful lapping lies mostly in the selection of the proper abrasive compounds. These should be bought from reliable manufacturers to insure that they are scientifically prepared as to uniformity of grain, that the grain will not be embedded in the material being lapped, that they will not be affected by temperature changes, and that they spread evenly, have a cool cutting action, and leave no grain marks. Ordinary shop mixtures should be avoided.

Let us consider a few lapping-in operations, such as fitting shafts and spindles in bronze or Babbitt bearings. It is well established that lapping cuts the time of a scraping job by at least one half and gives a far better metal-to-metal contact.

Lapping solid bearings, as shown in Fig. 1, is a delicate operation on account of the small clearance. First, the bushings (Fig. 2) should be ground internally with a diamond-dressed wheel, .001 in. under the finished size. A concentric and smooth bearing can be lapped faster and will be more accurate than one that is only bored or reamed. Since a primary lapping operation is needed in this case, a soft steel lap is made as shown in Fig. 3. A section is ground .001 in. under the present size of the bore to create a line-up. There is a slight taper on the working end of the lap; this will cause a gradual entry in the bore and prepare the bearing for the final operation.

Compound H-40 medium (according to the Carborundum system of designating grades) is applied to the lap and first



Lapping solid bearings is a delicate operation and requires the careful use of a primary lap.

bearing, and the lap is passed through the bushing and oscillated until it works fairly freely. The bearing then should be cleaned with kerosene. Continue the lapping until the intended spindle is a light wringing fit in the bearing. The second bearing is prepared the same way.

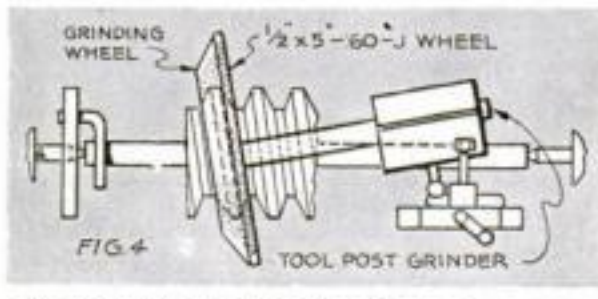
The first operation being completed, the bearings are thoroughly cleaned and the intended spindle is inserted for the final lapping. Compound H-40 fine is supplied to the bearings through the oil holes by pressure or is flowed in after being diluted with water. The spindle is oscillated until it revolves reasonably freely; it should then be run by power for ten minutes at 200 r.p.m. The spindle is removed and all parts are cleaned again and polished with felt before it is replaced. The bearings should be given a coat of sperm oil. As these lapping compounds have a very quick cutting action, it is advisable not to proceed too long before making an inspection of the work.

The lapping-in process for adjustable bearings requires no primary operation; nevertheless, two grades of compounds are used. Grade 40 coarse is applied to spindle and bearings; and after the spindle is replaced, both bearings are tightened until a light drag is felt. The spindle is oscillated by hand for five minutes, and the bearings are gradually tightened to a light contact. The next step is to remove the spindle and clean all parts. The operation is then repeated with Grade 40 fine. As in the case of solid bearings, the final lapping should be done under power, and the bearings gradually taken up. In both cases a belt about 1 in. wide should be used; it should be just tight enough to revolve the spindle.

The fact that one company produces twenty-two grades of lapping compounds clearly indicates that each type of operation requires its own mixture. A grade used on soft metals will not give results on hard surfaces; indeed, the principles that govern grinding wheels apply with equal importance to abrasive compounds.

Another important lapping-in operation is that required for finishing gears and worms. This is too often neglected when it is considered that a set of soft gears frequently can be lapped in five minutes. On a production basis, gears are lapped on special machines; in the average shop, the work is done while they are assembled in their cases or housings. This method is the best in one way because the position of the gears should not be changed. If they have to be removed, they should be marked and reassembled in their original position.

The following grades are recommended for soft gear operations: rough gears, W-7 coarse; smooth gears, W-7 medium for



In some cases, to save time in lapping, worms are trued in the lathe with a tool-post grinder.

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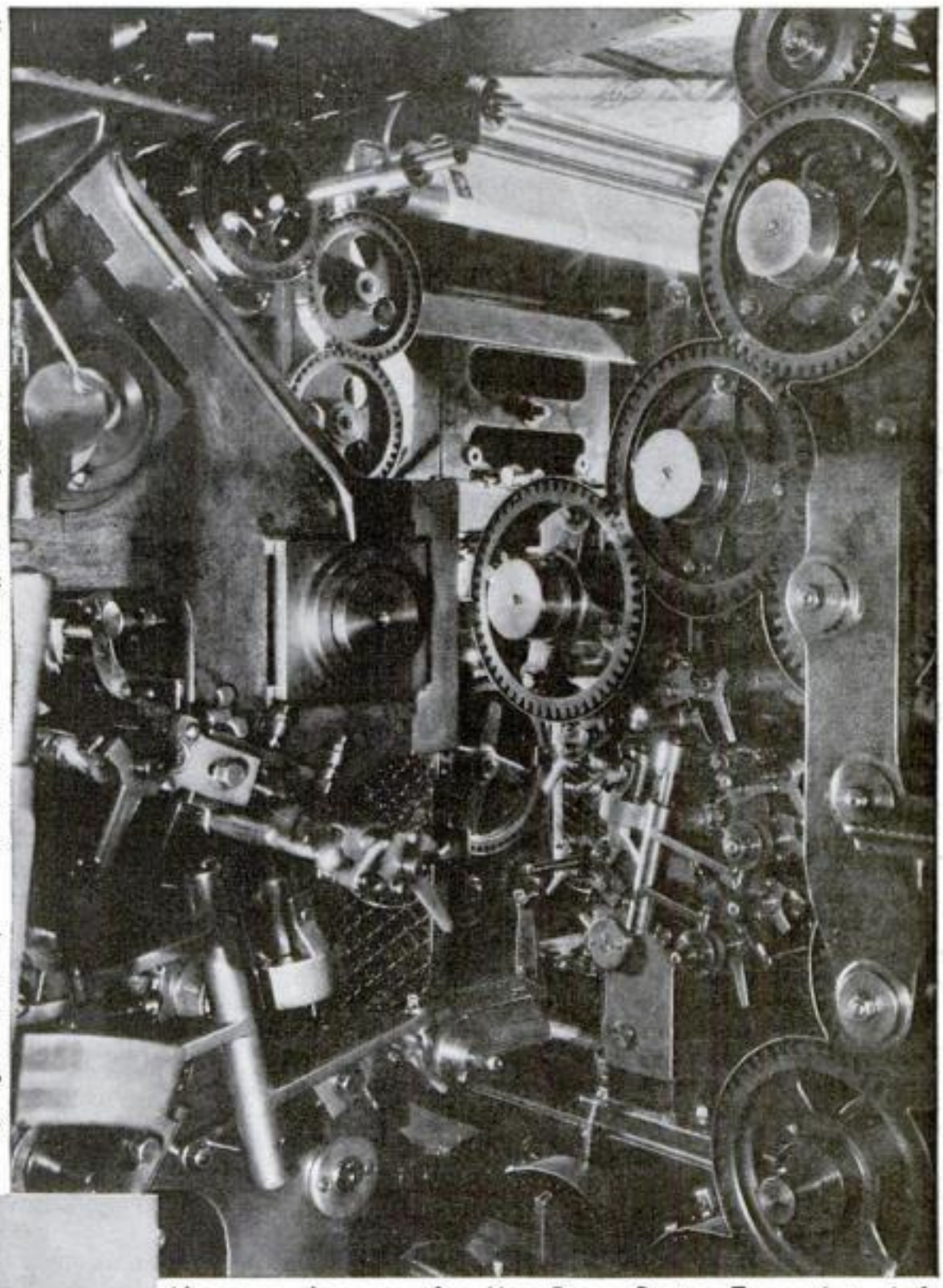

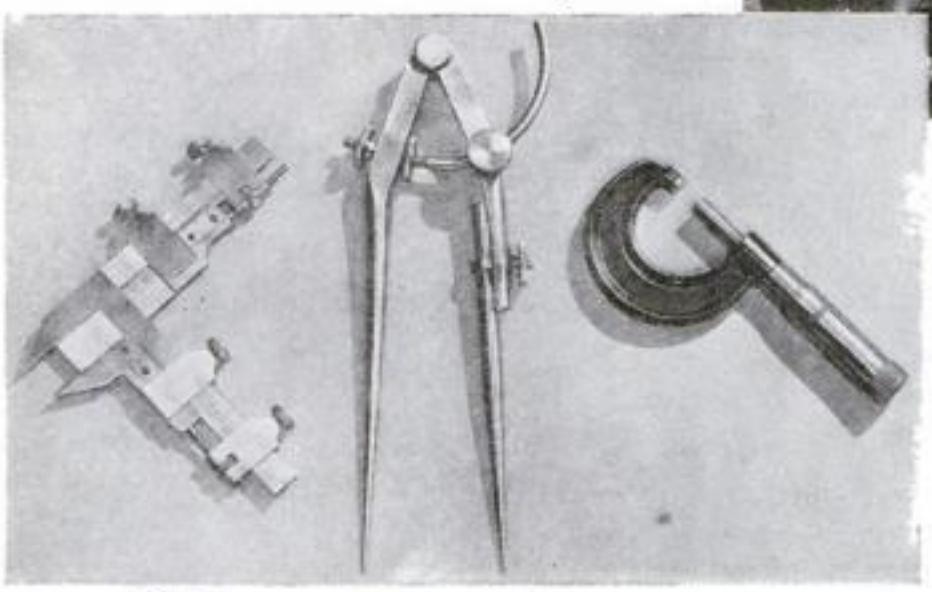

Above: a close-up of a Hoe Press, Boston Transcript. Left: Starrett Gear Tooth Vernier Caliper No. 456, a precision tool used in making gears. Starrett Dividers No. 92 and Starrett Micrometer No. 436, two splendid tools that belong in every kit. Below: the coupon. It will bring your free copy of Starrett Catalog No. 25 "W." Send it in.

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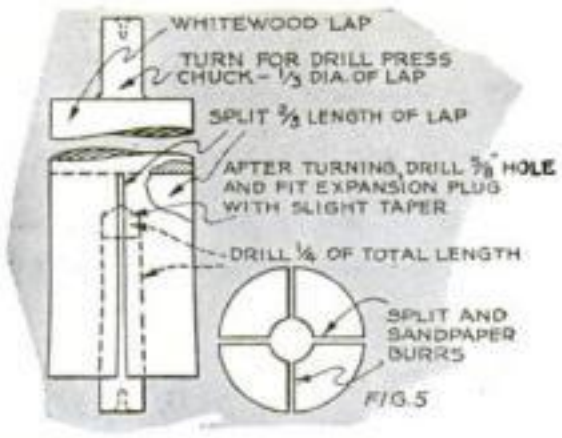


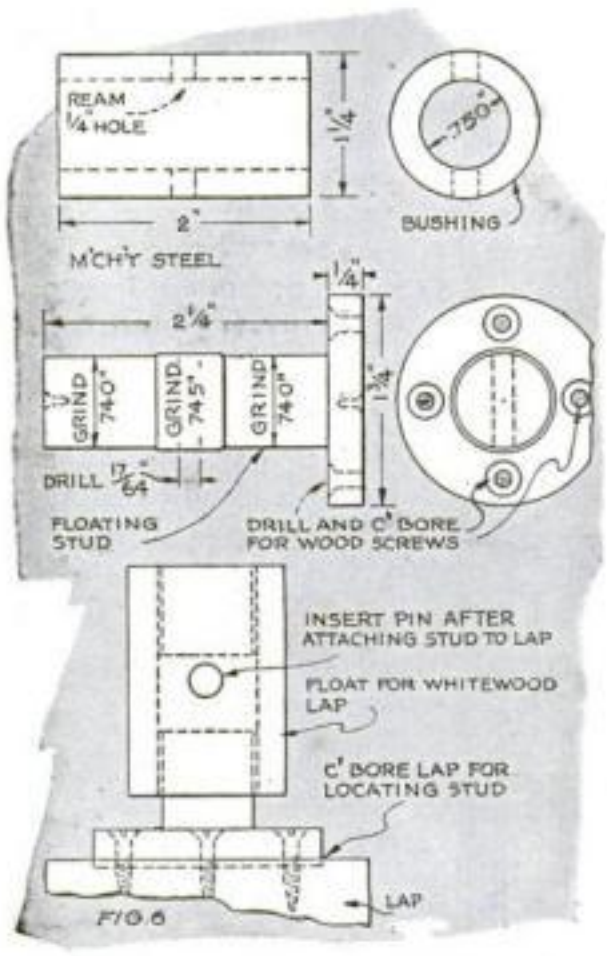
A whitewood lap, which can be made as illustrated, is economical and will give good results.

large sizes and W-7 fine for small sizes; for very small work and fine finish, H-40 medium. The compound is applied with a brush in a quantity so it will not drip. The gears should be run at a speed that will not throw off the mixture, and the operation should not continue any longer than necessary. The gears are easily cleaned by spraying them with kerosene. Hot water with one cup of caustic soda to the gallon is just as good.

When hardened gears are lapped, the distortion caused by hardening must be removed. In this case, as an allowance has been made by grinding the bore to a specified diameter, especially with worms, it is imperative that every section of the form be true and exactly concentric with the bore. Much care therefore must be exercised in truing up the gear or the worm before the internal grinding is attempted.

The distortion in hardening is noted mostly in worms. To save time in the lapping operation, it is advisable in some cases to true worms by grinding the pressure, or working, side of the thread, as in Fig. 4. The work is easily done in the lathe by tilting the tool-post grinder and using the side of the wheel dressed to the corresponding angle.

For hardened gears the following grades of compounds are suitable: for fast cutting and semifinish, R-7 coarse; for fine finish, especially small gears, R-4 fine.



In using the whitewood lap shown in Fig. 5, in a drill press, it is best to provide it with a float.

Large sleeves and bushings in many cases require a very smooth and concentric finish, especially if they are to be used for cylinder purposes. On any large production basis the honing process is used for cylindrical work, but the necessary equipment needed is not to be found in the average shop.

When the walls of large sleeves and bushings are finished by boring, reaming, or grinding, ridges will be found to a depth of from .001 to .002 in.; therefore lapping or honing is the only means of producing a finish that will hold the proper clearance and assure correct lubrication for the piston or shaft, as the

Fig. 7. Compare the dry ground surface above (magnified eight diameters) with the lapped surface below (magnified three hundred diameters).

Photographs Courtesy of the Norton Company

case may be. A lapping allowance of .002 in. may be made for bronze, brass, and cast iron; for hardened steel, .001 in. is generally sufficient. Work over 6 in. long and 2 in. in diameter may be satisfactorily lapped in the drill press. A whitewood lap is economical and will give good results. It can be made as in Fig. 5, but it is advisable to attach a float as in Fig. 6. The work is clamped to an angle plate, which in turn is bolted to the drill-press table.

The lap should rotate at approximately 200 r. p. m., the strokes being 100. The operation should be started with the lap relatively snug, but the friction should never be hard enough to generate the least amount of heat. The compound may be cut down with water if desired. For softer metals, H-40 fine is recommended; but in case the machine finish is not up to the standard, H-40 medium should be used first as a means of saving time. For hardened surfaces, W-7 medium is applied for a dozen strokes or so, and the finish produced with W-7 fine. Once the results have been obtained, a mirrorlike finish may be applied with a felt lap after cleaning the wall with kerosene to remove all foreign matter.

In a second article, Mr. Chamberland will give practical hints on lapping as used for finishing plug, ring, and snap gages in the tool room.

Old Bill *Says—*

YOUR magnifying glass will often reveal the true character of those dim figures on a blueprint.

Many a costly high-speed tool has been spoiled on the surface grinder because of the heat generated by too hard a wheel.

Do not try to save the time of a set-up by filing off any surplus material that can be removed by a machine. Nothing is to be gained by unnecessary handwork.

If the sleeves of your shirt or jumper are in your way, cut them off before the machine gets them—and maybe your arm.

We learn by watching others; we produce by watching ourselves.

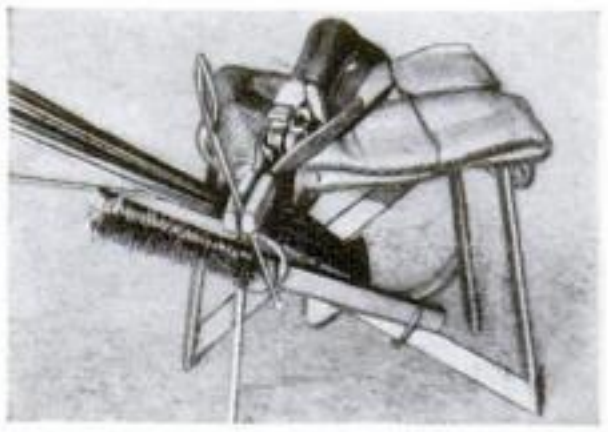
When grinding brass or aluminum alloys, it will help materially if the wheel is given a coat of mutton tallow or lard.

Sections of heavy-duty hack saw blades make useful cutting-off and recessing tools for the lathe.

SHOPMADE STOOL LESSENS WELDER'S FATIGUE

FOR the welder who is engaged in work that allows him to sit down, a handy, comfortable stool can be made from light metal bars, ¼ by 1 in., as shown in the accompanying photograph.

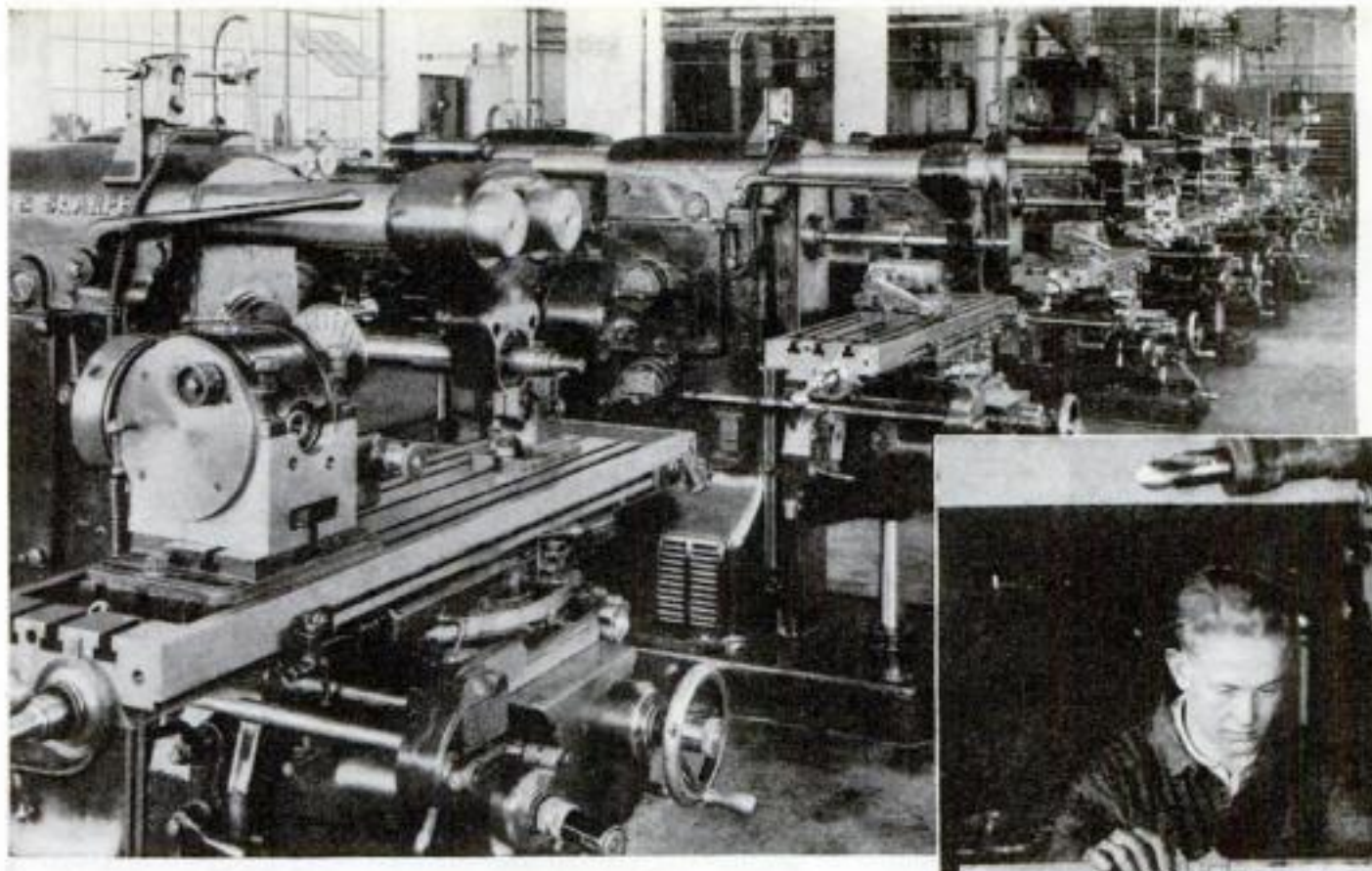
The top of the stool is a square frame of this material, 10 by 12 in., with heavy wire netting welded over it and



The welding rods and brush are placed so as to be within easy reach of the operator.

covered with burlap for a cushion. The legs, 14 in. long, are welded on, as are the angle braces. To one of the latter, two wire loops are welded for the workman's brush. Another loop of heavy wire, attached to the top of the stool in front, is used in moving the seat from place to place.

Beneath the seat is welded an 8-in. section of 3-in. pipe, closed at the lower end, for holding a supply of welding rods. This container is placed on the same side as the handle.—JOSEPH C. COYLE.



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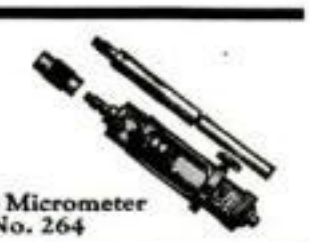


Inside Micrometer No. 264

Gifts You Can Make of Silver

How to shape an attractive hand-hammered tea strainer—Forming spoons and ladles

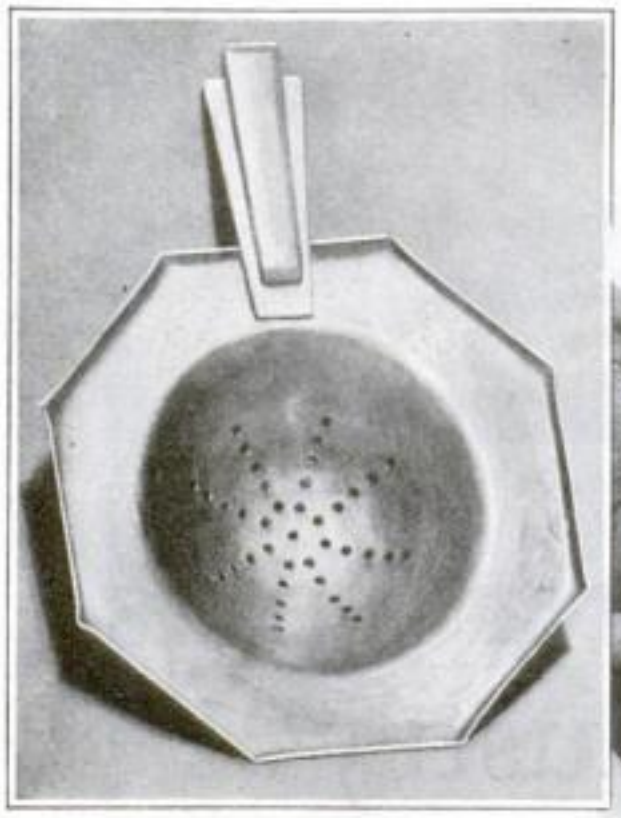
By EDWARD THATCHER

HAND-HAMMERED silver tea strainers form gifts of genuine distinction and therefore have a double appeal for the craft worker in metal, because after he has had all the pleasure of making them, he can put them to good use at Christmas time. Incidentally, in this way he can learn much that will help him later in making spoons and ladles.

The tea strainer shown in Figs. 1 and 4 was designed and made by the author especially to give readers of POPULAR SCIENCE MONTHLY a start in this enjoyable type of decorative metal work. It is of sterling silver, but a similar one could be formed from copper or brass and then silver plated; or monel metal, which does not tarnish, could be used.

If sterling silver is used, a 4 in. square piece of No. 22 gage stock should be obtained and cut eight-sided. Hammer the center of this piece as shown in Fig. 2 into a depression turned in a hardwood block, the hollow being the exact size of the outside of the bowl. Use a silversmith's raising hammer and start the hammering in the center. Anneal the metal frequently and take care to keep the outer edges flat.

When the bowl has been formed, invert it over a round-end iron stake (Fig. 3) and planish it with the planishing hammer in concentric circles, starting from the center. This is to remove all unevenness left by the raising hammer.



Above: Fig.1. A sterling silver tea strainer of modern design. *Right:* Fig. 2. Shaping the bowl of the strainer by hammering it into a depression in a block of wood.

The outer edges are turned up, one at a time, by placing the work bottom up over a sharp-edged flat hardwood block and using a mallet. Do not hammer at the corners, for they will form themselves as the edges are turned up evenly.

Fig. 3. Planishing the bowl with a planishing hammer to smooth away all unevenness left by the raising process.

The handle is formed of two pieces of metal, the lower one, which is soldered to the bowl, being of No. 20 gage, and the upper one, which is soldered to the lower piece, being of No. 16 gage. Silver pieces are usually hard soldered for durability (see P. S. M., May '30, p. 78), but if the strainer is made of copper, it may be soft soldered. The holes should be laid out in an attractive design and drilled with a 1/16 in. diameter drill. The completed piece should be pickled, Scotch-stoned, and polished.

It is a simple step from a tea strainer such as this to the making of spoons and ladles. These may be made in three different ways—hammered from one piece, the bowl formed separately and silver soldered to the handle, or the bowl and handle riveted together in the larger and more primitive forms.

Design and balance are particularly important. No matter how interesting spoons may be to make, they are of little value unless they can be handled and used conveniently. It is always a sound plan to study the commercial forms of similar articles which, regardless of artistic qualities, have the size and angle of the bowl and handle in proportion to one another and are always well balanced. The study of old spoons and ladles at one of our large museums will repay the craftsman. A few good examples of old Colonial spoons are shown in Fig. 5; these

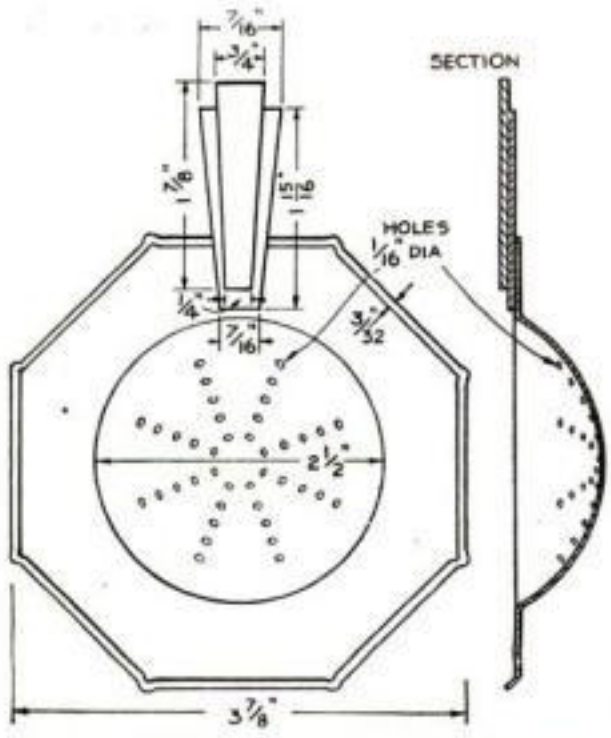


Fig. 4. A 4 in. square piece of No. 22 gage sterling silver will serve for the tea strainer bowl.

are well worthy of careful study.

The most satisfactory metal for spoons is sterling silver, but brass or copper may be used and the completed articles silver plated. It is advisable from the standpoint of economy to make your first spoon or ladle of copper or brass.

In the first—and best—method of making a spoon, a single piece of sterling silver, either No. 12 or 14 gage, is required. How large a piece to get will depend on your experience in gaging the amount to be hammered out. The bowl end must be thinned down considerably, and usually the end of the handle also, while the shank between the bowl and the handle are made thicker.

Figures 6 and 8 show a spoon made by the author as an example. The rough form is sawn out as indicated by the dark line in Fig. 8. Note that no sharp corners are left anywhere in the outline at this stage or cracks would be likely to develop in the hammering process. The shank *C* is left somewhat wider than it appears in the finished spoon; the handle *D* is narrower, while the bowl end *B* is considerably smaller. The blank is rounded at the bottom as shown at *A*.

Anneal and clean the piece after sawing it out. Then place the bowl end *B* on a flat, smooth steel anvil and use a hammer with a slightly rounded face to hammer it out or enlarge it, the work being kept flat at this stage. Start hammering at the outer edge and follow the general outline of the bowl. Be sure to anneal the metal each time it is hammered over. When the bowl is enlarged to a slightly larger diameter than it is finally to be, anneal it and planish it smooth with a flat-faced planishing hammer.

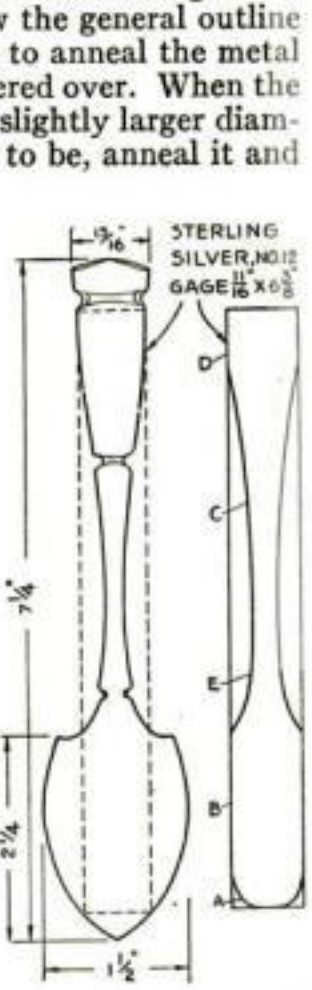
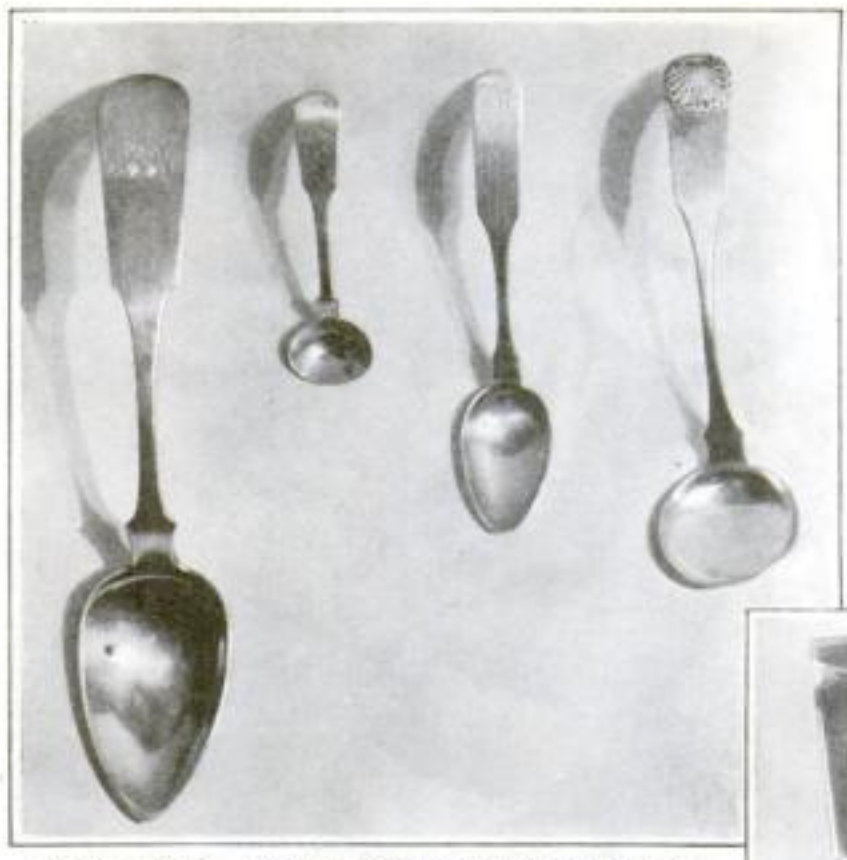


Fig. 8. The spoon and the sterling silver blank from which it is made.

Next, place the handle end *D* on the anvil and thin this end down, tapering the shank toward the handle from about the point marked *C* in Fig. 8.

To thicken the shank at *E*, place the metal edgewise on a flat-surfaced stake or anvil with rounded edges and use a hammer with rounded edges (Fig. 7). Anneal frequently. When the metal tends to form a channel shape, place the work flat on a suitable anvil and hammer down the raised edges at the sides, taking care that no metal is folded over on itself during the process; that is, unless you wish to make use of the channel effect in your design, as is frequently done. The weight of the metal at *E*, Fig. 8, combined with that of the bowl, determines the balance of the spoon.

The simplest way to form the bowl is to carve a suitable hollow in the end or side grain of a piece of smooth hardwood. With a small silversmith's hammer having rounded ends, start hammering in the center of the bowl and work around, conforming to the outline of the bowl. Anneal the metal several times during this process.



Above: Fig. 5. Samples of fine early Colonial silversmithing. *Right:* Fig. 6. An attractive sterling silver serving spoon made by the author as a sample.

The spoon or ladle bowl is then planished on the outside with a flat-faced planishing hammer. Special spoon stakes

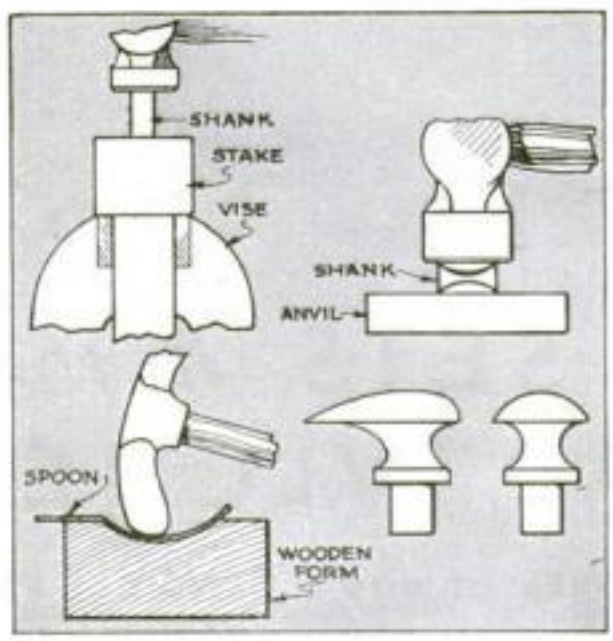


Fig. 7. Methods used in shaping the spoon and the special metal stake made for the purpose.

are sold for the purpose as shown in Fig. 7, but ladles are planished over the end of any suitable stake. Start the planishing in a straight line up and down the center of the bowl; then work around this to conform to the shape. When the bowl is smoothed up, trim off the extra metal remaining at the edges.

The outer end of the handle *D* is usually bent up slightly. The handle may be sawed to some design, or a silver initial letter may be silver soldered to it.

Next comes the important operation of curving the shank where it joins the bowl. Do this by placing the shank over a small rounded anvil and using a wooden mallet.

To make a really good job, the entire surface of the spoon should be planished over at the end of the work after the last annealing. This leaves the metal hard for use. The spoon or ladle is finished by rounding all edges with a file, smoothing the filed parts with fine emery cloth, and then using Scotch stone and water to smooth the entire surface before the final polishing.

A second method, which is more economical of the silver, is to make the bowl and handle separately and silver solder them together, the bowl being hammered out of No. 20 gage silver, for example, and the handle or shank made of a narrow bar of No. 12 or 14 gage, the two pieces being soldered together as in Fig. 9. The whole spoon is planished after soldering. In the same figure is also a suggestion for making a very large ladle entirely of copper or brass—a ladle such as is sometimes hung beside a fireplace. Here the handle is riveted to the bowl, which is hammered in the same way as any copper or brass bowl. The process was described fully in two earlier articles in this series (P. S. M., May '29, p. 79; and Sept. '29, p. 92). For polishing, see P. S. M., July '29, p. 80.

CAN OPENER CUTS STEEL LEADERS AND GUTTERS

IN PUTTING up new leaders and gutters around my house, I found it almost impossible to cut them with shears or hack saw. Then I hit on the idea of using a can opener. I started at the back of the gutters, which were of No. 28 gage galvanized steel, and cut around to the rolled front edge. This edge I severed with a hack saw. In cutting the leaders, I first punched a hole alongside the seam with the point of a screw driver, inserted the point of the opener, and worked it around to the other side of the seam, which I cut through with the saw.—J. S.

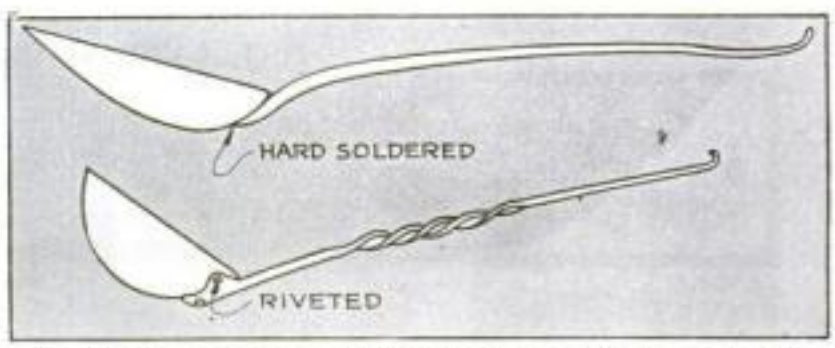


Fig. 9. Spoons and small ladles can be made in two parts, the handle and bowl either being riveted or hard soldered together.

Smart Looking Wooden Seats for the Porch or Lawn

Plain butt joints, fastened with screws, are used throughout the construction of these porch chairs.

By JOHN M. CHITTENDEN

WOODEN furniture for the open porch or lawn such as is shown in the accompanying photographs and drawings is distinctive, unusually comfortable, and relatively simple to construct since no complicated joints are used. It has the additional advantage of standing exposure to the hardest kind of use. While furniture of this type is expensive to buy in the more exclusive furniture and housefurnishing shops, it can be made in the home workshop at low cost for materials.

Small woodworking machines will help in the building of these pieces; but by varying the dimensions as necessary to suit the stock sizes of lumber, they can be made easily with ordinary hand tools.

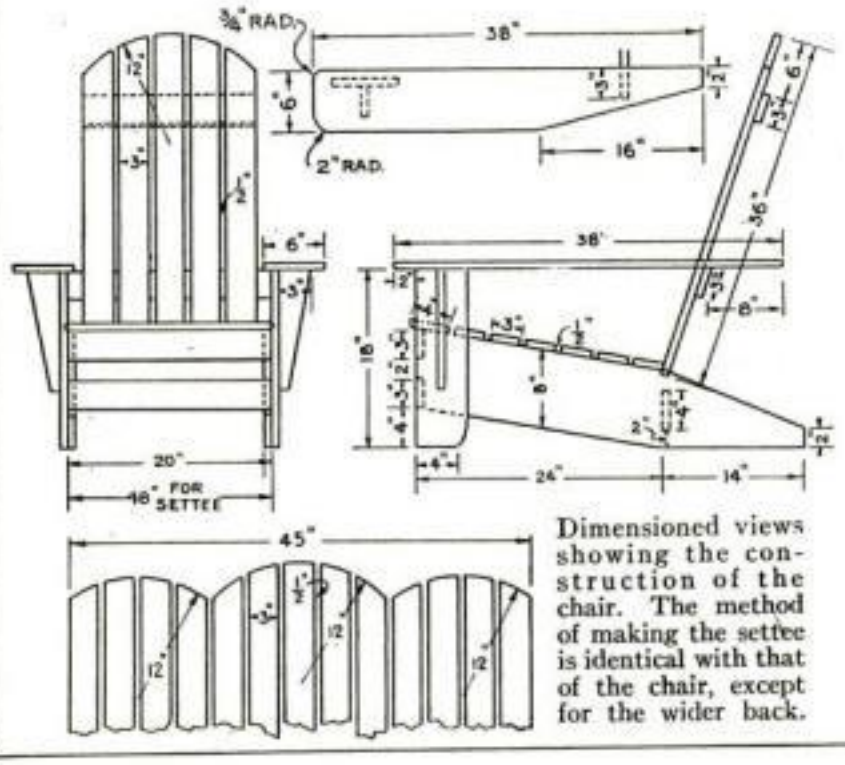
Remember that stock lumber is a trifle smaller than ordered, a piece 1 by 3 in. being actually about ⅞ by 2¾ in. The material used can be any easily worked wood that is thoroughly seasoned, such as white pine, cypress, or fir. The writer used 1 by 12 in. white pine boards and ripped them to the required widths on a small power saw.

Comfort and durability make this armchair especially well suited for either porch or lawn.

Plain butt joints are used throughout, the parts being held together with 1½-in. No. 14 flathead screws. Countersink all screws and putty over the holes.

If desired, a rocking-chair of this type can be made by making the long feet curved instead of straight and cutting the front legs short so that they will not come below the rockers.

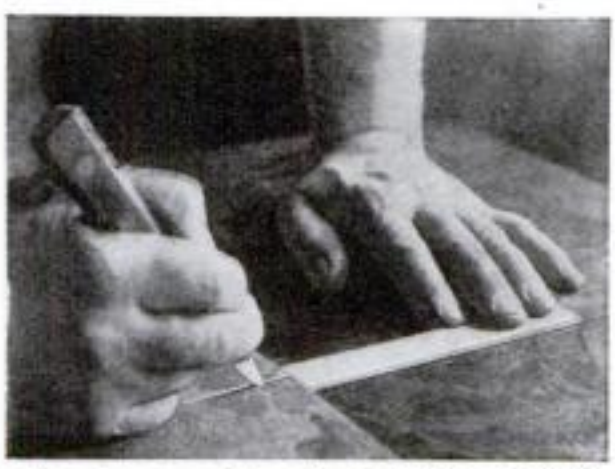
Three coats of a good grade of house paint, the priming coat being thinned with linseed oil and turpentine, will give a satisfactory and durable finish for outdoor use.



Dimensioned views showing the construction of the chair. The method of making the settee is identical with that of the chair, except for the wider back.

KNIFE POINT GUARD FOR CUTTING LINOLEUM

IN LAYING linoleum, it is usually cut to size on the floor, but an objectionable feature of the operation is that the point of the knife digs into the floor and causes bad scratches. If the floor is a good one and may some day be used again without a linoleum covering, the lines will be a



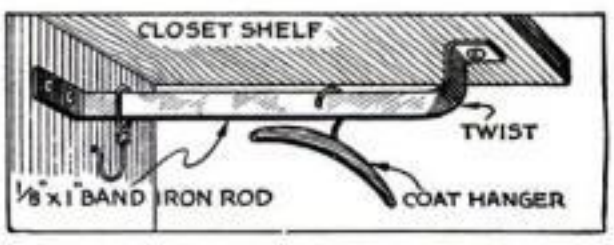
By using a wooden rule or stick as a guard you can cut linoleum without marring the floor.

blemish almost impossible to hide. It is therefore better to cut the linoleum by placing a wooden rule or strip of wood underneath and digging the point of the knife into this so that as the cut is made across the linoleum the rule will slide along and prevent the knife from touching the floor.—H. MOORE.

BAND IRON SUPPORT FOR CLOTHES HANGERS

A STRONG support for clothes hangers and sliding wire clothes hooks may be made quickly and easily from a length of common band or strap iron. Supports of this type will not sag, as the iron is used edgewise; and a number of garment hangers may be hung on one rod, which may be of any desired length.

These rods may be run at right angles to the shelf to which they are fastened, or one rod may run the length of the shelf,



A vise and a monkey wrench are the only tools needed to bend the band iron support to shape.

parallel to it. In the latter case it may prove convenient to make a twist and angle at each end of the bar instead of the single twist shown, which is for a short bar.

Band iron is easily bent cold by holding one end in the vise and gripping the other with a monkey wrench, or it may be held in the vise and hammered over at right angles. It is well to drill the screw holes before bending.

These supports can be neatly finished with paint or lacquer. The wire hooks are made by bending galvanized wire about ⅛ in. in diameter.—E. T.

She'll like this gift of a

Handmade Sewing Case

The design on the leather case may be hand tooled or embossed with a carved linoleum die.

By F. CLARKE HUGHES

LEATHER is so plastic and so easily manipulated that it holds a place in the front ranks of materials for the craft worker. It is particularly appropriate for making such articles as the little sewing case or thread case illustrated. Any woman or girl who travels will find frequent use for a case of this kind.

A piece of tooling calf, another of lining kid, both about 3 by 3½ in., and two small disks of wood are the only materials needed. The main piece, marked No. 1, should be cut first. If the round ends are to be 1 in. in diameter, the length of this piece will be approximately 3½ in., the extra allowance being for the lap at the joint.

Before the holes are punched in the edges of piece No. 1, the two 1-in. disks should be cut from soft white pine ¼ in. thick. These should be faced on one side with thin lining leather and on the other with the thicker calfskin, as shown. Then the two strips marked No. 2 should be cut out and punched. Note that the holes are placed so that they fall at each end; one half the strip in the center is left unpunched. Attach the strips to the wood with rubber cement or flexible glue and drive a nail at each end.

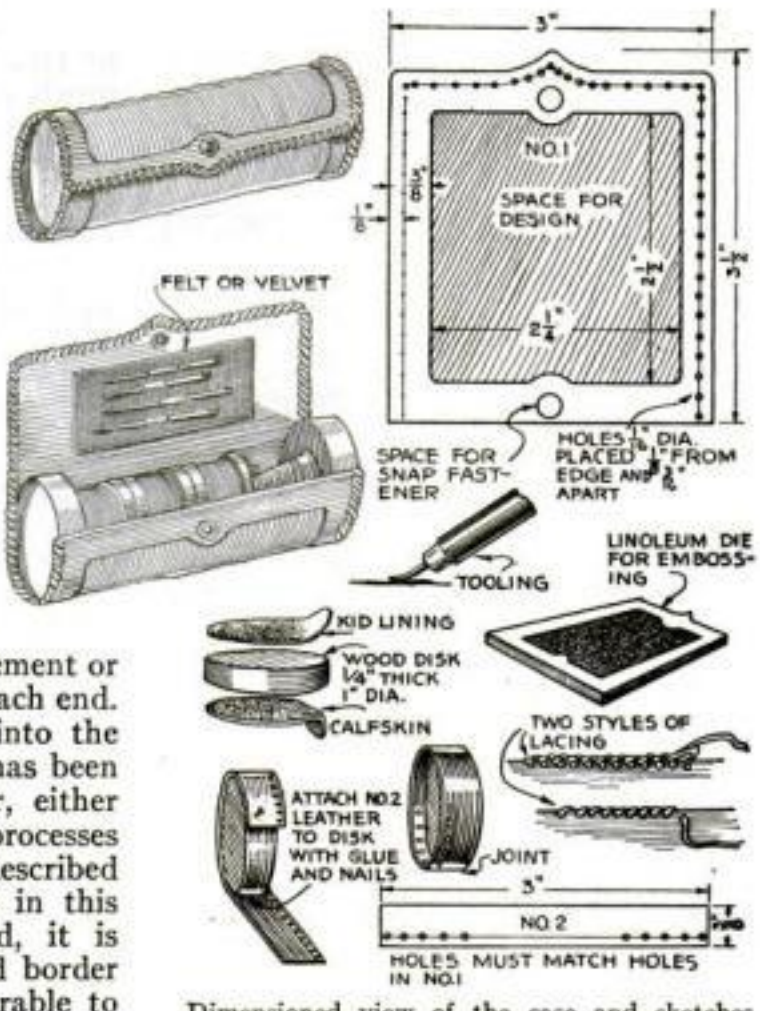
A design should be worked into the surface of piece No. 1, after it has been thoroughly softened with water, either by tooling or embossing. Both processes are illustrated and have been described frequently in preceding articles in this series. If the design is tooled, it is sufficient to use a simple veined border line; but if embossed, it is desirable to use a stippled panel effect such as is shown in the drawings of the finished case and carved linoleum die.

When the leather has been decorated, the lining should be glued in place by running a very narrow line of adhesive around the edges. Then the holes should be marked and punched. The laces may be cut from any scraps of thin, flat leather, although kangaroo or wallaby skin is the best suited. They should be about ⅛ in. wide. Note how the lace is used to fasten piece No. 1 to the two ends and how it is continued around the edges of piece No. 1 to give a neat finish.

A peg may be attached to one disk on the inside to hold the thimble, if desired, and a piece of felt or velvet glued inside the case, as indicated, for needles.

Attach a snap fastener or take the case to a shoemaker and have him do it, and then polish the outside of the case with wax or ordinary shoe dressing.

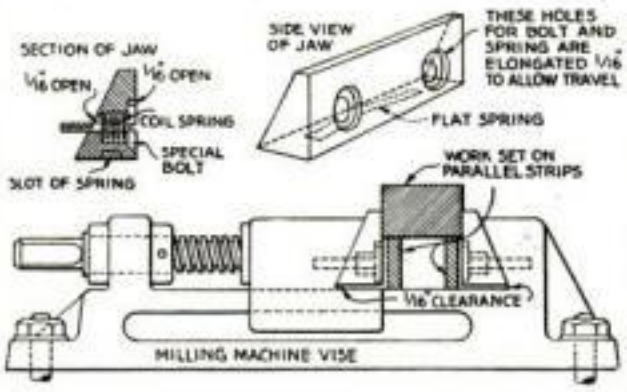
TO REMOVE white spots on furniture, the following method has proved generally satisfactory: Saturate a soft cloth with camphor and another smaller one with sweet oil, olive oil, machine oil, or even butter or lard. Dust the surface thoroughly, then rub the spot lightly with the camphor, beginning at the edge. After each stroke of the cloth, immediately apply the oiled rag. This must be done quickly, because the alcohol in the camphor will remove the varnish if it is left on the surface too long. Continue until the spot disappears, working very swiftly. Then polish the surface in the usual way.—MRS. K. B. C.



Dimensioned view of the case and sketches showing the case, ends, tool, die, and stitching.

SIMPLE VISE JAWS HOLD WORK PARALLEL

FOR machining work exactly parallel, the modified jaws of the milling machine vise illustrated are an improvement. They pull the work tight against the parallel strips so that the finished work is bound to be parallel. With the ordinary jaws, there is always a tendency for the work to lift away from the parallel strips in the process of tightening the vise.



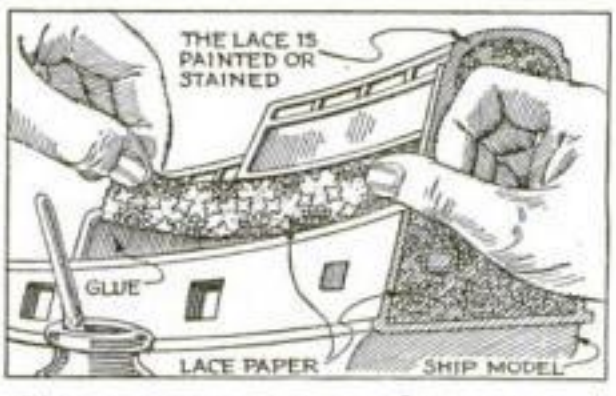
The writer uses these modified vise jaws daily in his machine shop in Melbourne, Australia.

When this occurs, the top and bottom faces will not be true, no matter how carefully machined.

Since making the vise shown, I have used it almost daily, and believe other mechanics will find the idea helpful and be well repaid for making vise jaws of this type.—H. B. J. LOWE.

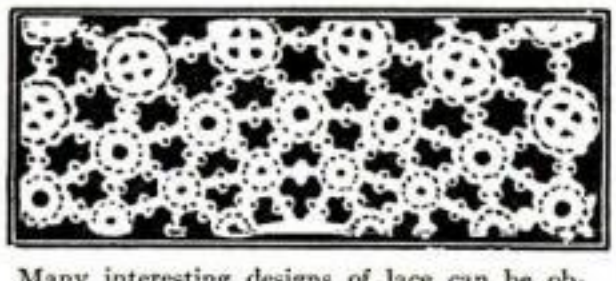
LACE PAPER DECORATES SHIP MODELS

SHIP model makers who find the decorative work about the stern and bow of such ships as the *Mayflower* the most tedious part of the model construction can overcome this difficulty by the application of lace paper such as is included in candy boxes or used as borders on paper



The use of lace paper eliminates a difficult problem in the decoration of ship model hulls.

napkins. As can be seen from the illustrations, all that is necessary is to trim the lace paper to size, glue it in place, and then to paint it over in whatever color is desired.—JOHN F. NICHOLS.



Many interesting designs of lace can be obtained from paper napkins and candy boxes.

Lighting Your Home Workshop

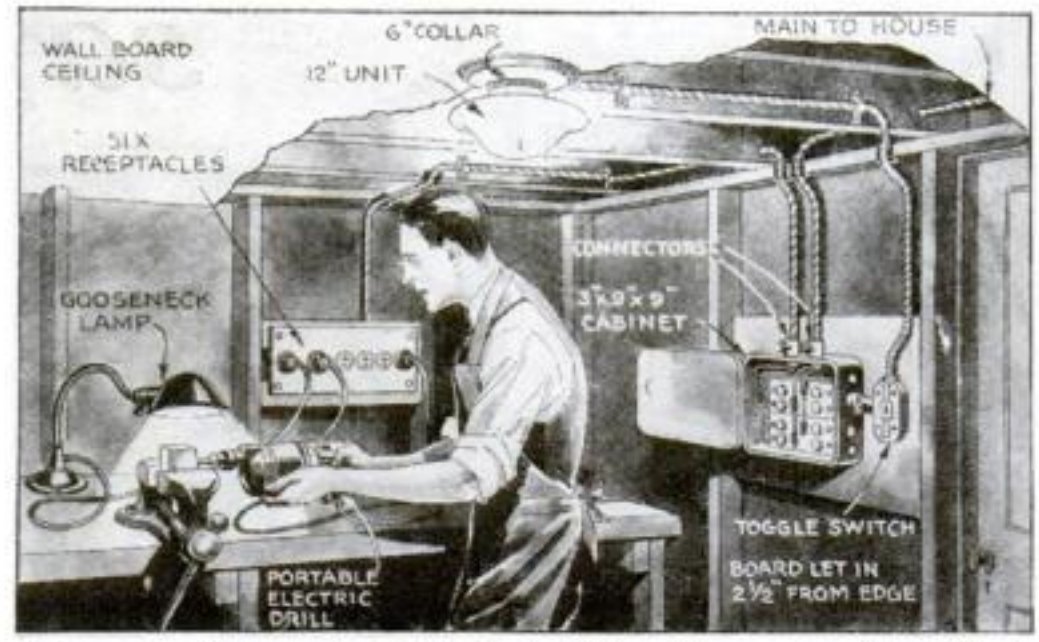


Fig. 1. A small shop can be lighted effectively through the use of a ceiling light and several gooseneck lamps. Notice the six-gang receptacle placed over the bench.

How to install wiring and fixtures that insure ideal illumination at every bench and machine

By HAROLD P. STRAND

PROPER lighting of the home workshop is a subject of prime importance to every one of the increasing number of men who find pleasure and relaxation in handicraft. To work in a poorly lighted basement shop not only endangers one's eyesight, but may be the cause of accidents now that power machines are so generally used. Furthermore, accurate work cannot be done without sufficient light.

Hanging drop cords with a bare, glaring bulb dangling at the end—sometimes used to furnish light over benches and machines—represent the crudest form of lighting and the one most trying on the eyes. Modern illuminating engineers have found ways to provide an even, glareless light which is so easy on the eyes that it makes working after dark a pleasure. This type of illumination can be applied easily to any home workshop.

Since home workshops differ in size and arrangement, since certain delicate types of work require better than ordinary illumination, and since older men are likely to require stronger light than younger craftsmen, it is not possible to lay down hard and fast rules to fit every case. With the following suggestions, however, you should be able to obtain that ideal degree of artificial illumination to answer the particular requirements of your shop.

Lighting engineers figure the amount of light on the basis of foot candles, the criterion in workshop lighting being the

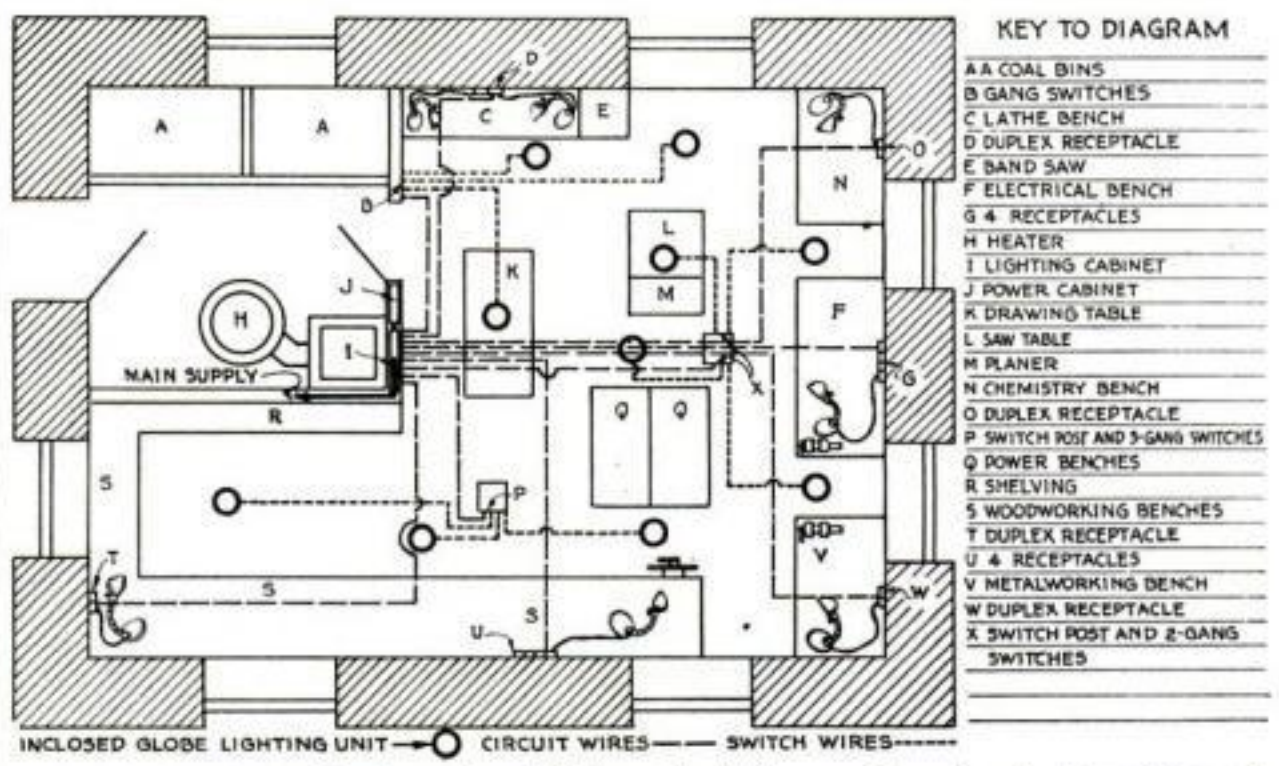


Fig. 2. Wiring diagram for a large shop. This layout is wholly suggestive and can be changed to meet the needs of any shop. The switches for the ceiling lights are conveniently placed on switch posts.

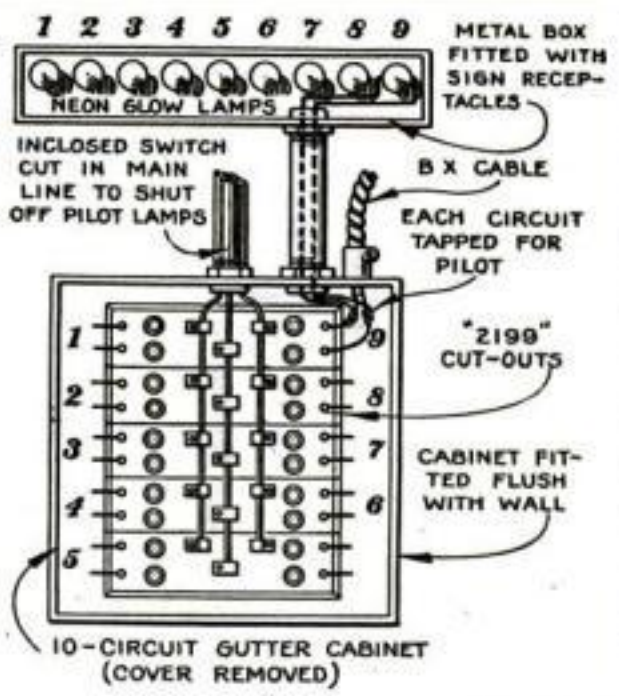


Fig. 3. If each circuit has a neon glow pilot light, blown-out fuses can be readily located.

foot candles at the bench level, which should be at least twenty, according to one of the leading authorities, while the general illumination for the floor area should be at least ten foot candles.

To decide which type of fixture will produce this standard it is necessary to take into consideration the color and cleanliness of the walls and ceilings of the area to be lighted, the height of the room, and the nature of its contents, whether light reflecting or light absorbing.

If you have rough floor beams and flooring boards for the ceiling of your basement shop, they should be covered with wall board after the wiring is in place. The boards then can be painted white or, better still, enameled. When the cellar ceiling is plastered, the wires may be fished over the plaster, as would be done in an upstairs room, and the plaster kalsomined or painted white.

It is a good plan to close in the masonry walls with wall board to make the shop warmer and drier and to help diffuse the light. To paint the wall white or a light color is highly desirable. If one does not care to close in the side walls, they may be coated with white cold water paint.

Fig. 4. How the switch posts are constructed.

Before attempting the wiring, visit whatever authorities enforce the wiring rules in your city or town and inquire if there are any special requirements. It is assumed for the purpose of this article that the rules of the National Board of Fire Underwriters, commonly known as the "Code," are enforced, as is usually the case. The material recommended is BX cable, which is the easiest wiring material for the amateur electrician to use

A suggested layout for a small shop for light work occupying a corner of the cellar is shown in Fig. 1, the wire and fixtures being exaggerated in size for clearness. The central lighting unit, which is controlled by a wall switch near the entrance, consists of a 12-in. white opal globe mounted on a ring with a 6-in. collar. The globe entirely incloses the bulb,

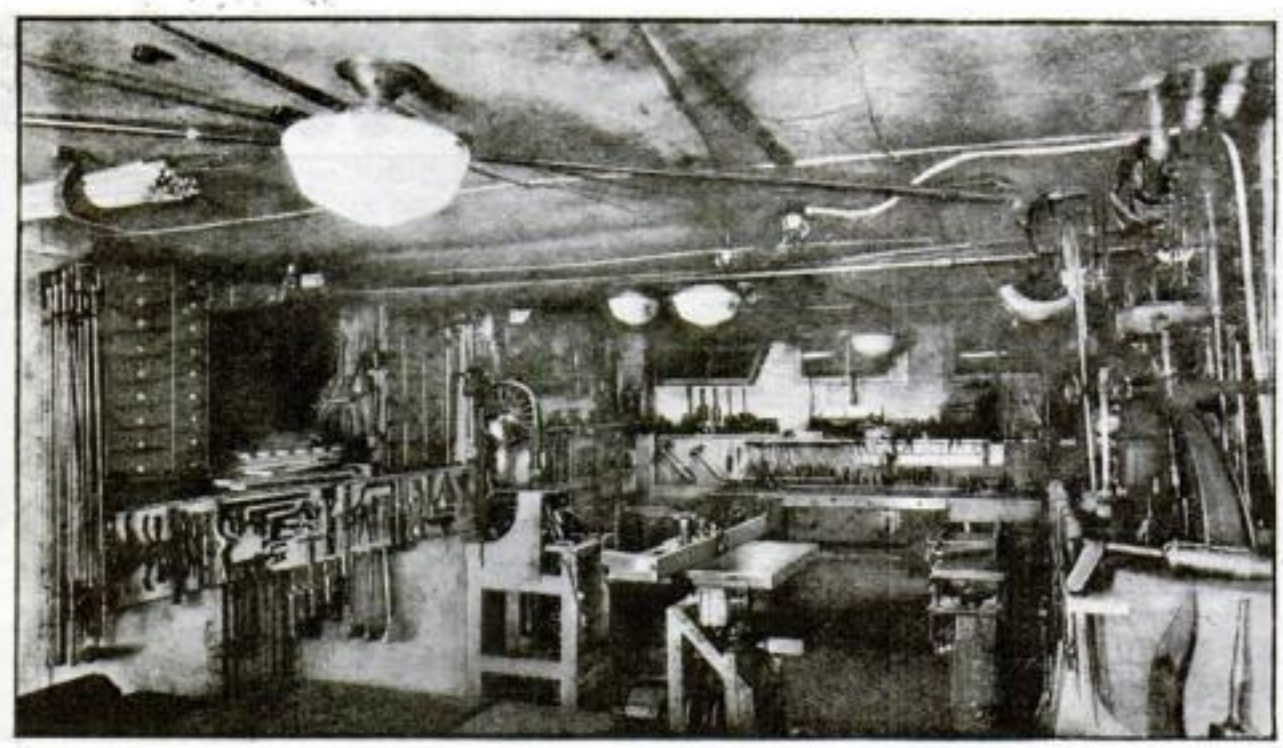


Fig. 5. An example of a well-lighted shop. Proper illumination not only makes working at night a pleasure but reduces errors and accidents to a minimum. A well-diffused light forms fewer shadows.

which is of from 150 to 200 watts, according to the intensity of light desired.

Over the bench a group of six receptacles is provided. Two or more gooseneck portable lamps can be plugged into these for the illumination of fine work, and the other outlets are handy for general testing purposes and for the electric drill, soldering iron, extension cord, and various appliances.

THERE are two circuits, one for the central unit and one for the bench receptacles. This insures light in the shop even if a short-circuited cord is plugged into a receptacle and blows the fuses. The fuse cabinet is accessibly located on the wall, and a feed to this cabinet is run from the house fuse cabinet, where a connection is made to the submains supplying the latter from the meter. Care should be taken to use wire of the same size as the submains, if it is Nos. 12, 10, or 8. If the submain is a larger size, the cable supplying the workshop cabinet will have to be connected to it through a cut-out, as required when reducing the sizes of wire for a connection.

In the shop, a ¾-in. octagonal outlet box is used in the ceiling; it is screwed to a board fastened up between the beams a distance sufficient to make the edge of the box flush with the surface of the wall board when the ceiling is finished.

If the wire is to be concealed on the side wall over the bench, regular receptacles are used, six boxes being joined together in gang formation. On the other hand, if the wiring is to be exposed, 3¼-in. octagonal boxes are used by joining them with ½-in. close nipples, checknuts, and bushings; or, if one chooses, he may use a surface-type six-gang box instead.

A shop of very small size, especially if no very fine, accurate work is done, may be lighted by a regular kitchen unit fixture, which uses a 9-in. globe, but for all-around lighting in the average small shop of perhaps 10 by 12 ft. the larger unit is recommended.

In Fig. 2 may be seen the wiring layout for lighting a larger basement shop well equipped with benches, power-driven machines, and worktables. The lights are placed between machines and benches, the idea being to throw the light from the side so that the worker will not create a shadow. The same 12-in. globes are used.

The circuits are arranged to supply the lights in three groups. This allows the use of lamps of high wattage, if desired, and also makes it possible to maintain light in the shop if trouble develops in or around a fixture or appliance.

Each worktable or bench is supplied with receptacles to allow the use of gooseneck desk lamps or other equivalent, and each group of ganged-up receptacles over a bench is in a separate circuit. It is a good plan, if one so desires, to terminate the wiring over each bench in the cut-out box, with the fuses handy. All fuses, however, may be placed in a steel cabinet at some convenient point on the wall, and each pair of fuses marked for identification. This method is shown in Fig. 2.

Because of the shiny tools and materials used in a shop, there is always apt to be a local glare, no matter how excellent the type of lighting unit used. If the units cannot be placed so as to avoid this and still be so located to give proper light on the work, the remedy is to use some form of indirect lighting fixture, where the light is reflected upon the ceiling and thence down to the work. This is possible only when the ceiling is sufficiently high and is smooth and white. The fixture sometimes is composed of a glass bowl which allows some light to pass directly through, although the bulk of the useful illumination is obtained by the reflected light from the ceiling. This is known as semi-indirect lighting. If the ceiling rafters are not covered, lights with opaque reflectors should be used.

AN EXCELLENT idea, shown in Fig. 3, is to connect a pilot-light socket across each circuit on the load side of the fuses. These sockets may be mounted in a row over the fuse cabinet. In each is screwed one of the new neon glow lamps, which burn with a bright red hue, yet consume but half a watt. The worker can glance at the row of lamps and tell instantly if all circuits are in working order; or with a lamp out, he knows which circuit is dead and can place his hands directly on the blown fuse. A master

switch is connected in the line supplying the load, which is opened when he leaves the shop, shutting off all power.

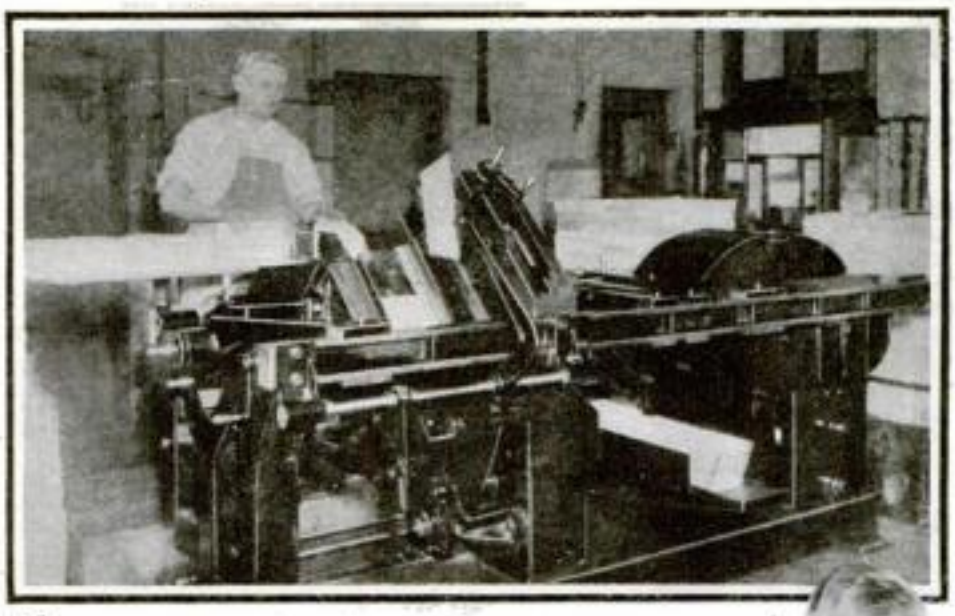
In a workshop which uses much electricity some saving can be effected by wiring for a three-wire distribution, provided that the three-wire system is being used elsewhere in the building. This means that instead of carrying the load on two main wires, it is evenly divided and placed on each side of a neutral or third wire (see Fig. 3). This provides better results and is the system used in all large buildings. It has the added advantage of allowing the motors on the power machines to run on 220 volts, provided, of course, that the motors are 110–220 volt type. This is possible because the potential on a three-wire system is 110 volts across the neutral and either outside wire, and 220 volts across the two outside mains. When a motor is started on this system there is no great "dip" in the lights, as is noticed when all the equipment is operated on the straight 110-volt system. The wiring of each circuit is the same as for two-wire distribution, but in the cut-out cabinet the so-called "2199" type three-to-two wire cut-out blocks are used.

IN SELECTING material, get standard equipment which will be uniform and interchangeable with other makes of the same type. For instance, Edison bases are standard for lamps, fuse plugs, and all screw-in devices. Two-prong parallel plugs are standard for the attachment of cords to receptacles, while among the standard outlet boxes is the 3¼-in. octagonal for ceiling outlets where timbers are open and suitable support is possible. For cases where the wiring is to be "fished" over an already existing plaster ceiling, the box is screwed to the laths, using a standard BX type outlet plate with a ⅜-in. stud in the center to which the fixture support is screwed. For wall boxes in all concealed work, for either receptacles or switches, the standard is the regular 2 by 3 in. oblong box with ears for attachment to the plaster or other surface. The standard switches at the present time are the toggle type for either surface or flush use.

TAKE special care to solder all joints and cover them well with rubber and friction tape. Join all ends of BX cable to the boxes with standard box connectors, which clamp around the end of the cable, and lock them to the box with lock nuts. In cutting off an end of the cable, take care not to cut into the wires with the hack saw, and see that there is no sharp end of the armor pressing into the insulation which might cause a "ground" later on.

The cable running in the direction of the floor beams is attached with small pipe straps sold for the purpose and short nails. In crossing timbers, bore holes through them with a 11/16-in. bit, keeping them up from the lower edge of the timbers sufficiently far so that nails from the wall board will not puncture the cable.

In a second article scheduled for early publication will be told how to plan and install the wiring for power machines.



The Smyth Book Trimming Machine

Photographed in the plant of J. J. Little & Ives which has cut as many as 20,000 books in a day, proving that the cutting knives were working with maximum efficiency.

Whittling a Flying Wing Model

By DONALD W. CLARK

FROM the standpoint of the airplane model maker who likes novelties, one of the most unusual designs is the so-called "flying wing" recently developed in California—a batlike little plane of 30-ft. wing spread with a pusher propeller (see P. S. M., May '30, p. 53).

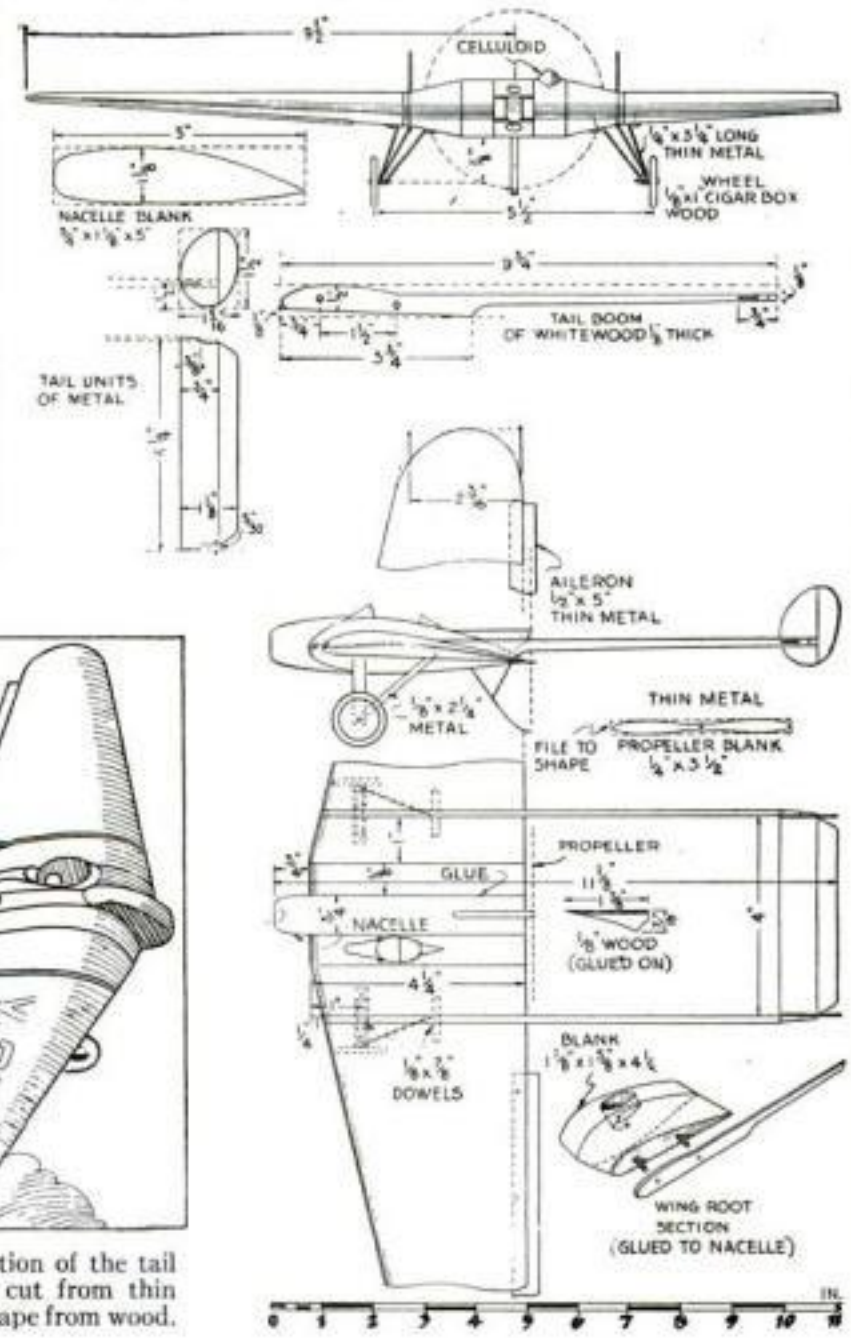
The accompanying drawings are for an easily made toy model of this flying wing. The construction corresponds in its simplicity to the preceding five designs in this series of model airplanes.

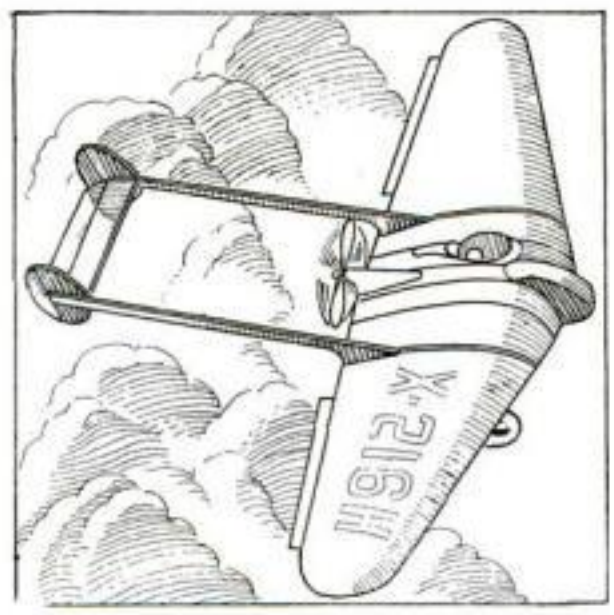
Begin by whittling the nacelle for the motor from a soft white pine block ¾ by 1⅛ by 5 in. To this is attached the wing, made in four pieces—two root sections and two main parts. The root sections are each cut from blocks 1⅛ by 1⅝ by 4¼ in. and are glued to the nacelle. Note that there is a cockpit only in one of these.

The remainder of the wing is carved in one piece from a straight-grained white pine blank ½ by 4 by 15 in. and cut in half. The two parts are attached by means of ⅛-in. dowels ⅞ in. long to the root sections, although the tail booms go in between and are held in the joint, as it were, by the same dowels. These booms, being only ⅛ in. thick, should be cut from whitewood or some other wood a little harder than white pine.

The tail units are of thin metal mounted on the booms by the usual slot and hole method. The propeller, which is of metal, is fastened with a nail to a small wooden support shaped as shown and glued to the nacelle. The landing gear and skid are made as illustrated.

In painting the model, the nacelle, tail booms, rudders, and landing gear may be a jade green; the wings, tail and propeller cream; and the tires black.





All of the parts, with the exception of the tail units and propeller, which are cut from thin sheet metal, can be whittled to shape from wood.

MOTH "GUN" USED FOR SPRAYING PAINT

IN THE absence of a regular paint sprayer, baskets and other small objects which are difficult to decorate with a brush may be painted quickly and satisfactorily with a small "gun" such as is used in spraying moth and fly preventives. Either paint or brushing lacquer may be used if thinned—each with its own medium—to the consistency of water and poured into the tiny tank.

While pumping, turn the basket several times, and one coat will be sufficient. After the foundation coat is dry, gilt may be sprayed on in the same manner to add a decorative touch to the handle and the top and bottom edges. If preferred, the gilt may be mixed directly with the lacquer, as it will shine through the color sufficiently when dry to give the desired effect.

Lacquer thinner, gasoline, turpentine, or turpentine substitute will clean the "gun" for a change of color. There is no waste, for left-over colors may be saved in screw-top jars.—A. MAY HOLADAY.

OLD putty can be softened to make its removal easier by running a hot soldering iron along it.—O. C. H.

BLUEPRINTS FOR YOUR HOME WORKSHOP

TO ASSIST you in your home workshop, POPULAR SCIENCE MONTHLY offers large blueprints containing working drawings of a number of well-tested projects. Each subject can be obtained for 25 cents with the exception of certain designs that require two or three sheets of blueprints and are accordingly 50 or 75 cents as noted below. The blueprints are each 15 by 22 in.

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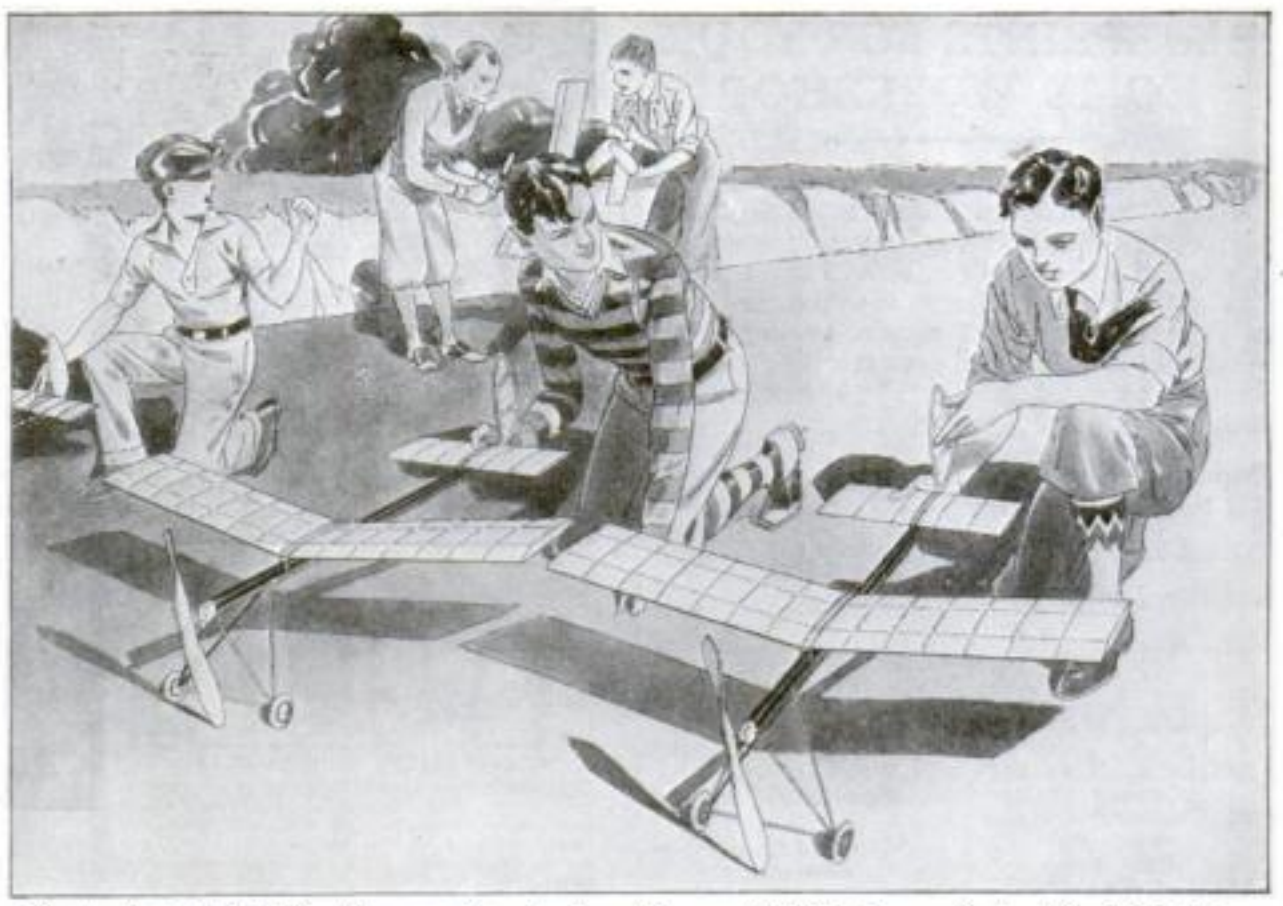


Fig. 1. Instead of holding the propeller when launching an R. O. G. plane, raise the tail sufficiently to allow the tip of the propeller to touch the ground, and on receiving the starting signal merely drop the tail.

Hints on Model Meets

By EDWIN T. HAMILTON

IT IS in the keen competition and breathless excitement of the airplane model meet that the model builder gains the most coveted reward for the time and labor he has spent in building and testing his planes. To make the best possible showing with his models, however, he should know just how contests are usually conducted and what preparations he should make.

Those wishing to participate in any meet can obtain complete instructions long before the date on which it is held.

The average well-conducted meet usually comprises the following events:

INDOOR CONTEST

1. Endurance models, hand launched
2. Endurance, rise-off-ground (R.O.G.)
3. Endurance, rise-off-water (R.O.W.)
4. Nonflying models, built to scale

OUTDOOR CONTEST

1. Endurance, hand launched
2. Endurance, rise-off-ground (R.O.G.)
3. Endurance, any motive power other than rubber

These events are usually divided into two classes, juniors and seniors. The former include only those under sixteen, while the other is for those over sixteen and not yet twenty-one. These ages, however, may be changed to meet local conditions.

Through attending meets all over the country, I have learned one thing which all model builders should keep in mind. That is the fact that weather often plays a great part in determining winners. Some models prove to be record-breakers in high winds, while others may leave them far behind on calm days. Any well-constructed, average-flight model has a chance to make a national record under favorable conditions, so why leave it at home, when no one knows under what weather conditions the meet will be held?

The next major consideration is what to take with you. Assuming that the builder has chosen the best models he has made for each event, his next step should be to duplicate each of these models. Then, if one should be broken, he will have a "spare."

Below is given a list of materials, parts, and tools other than his models and "spares" that the model flyer should carry with him to a meet.

1 twin winder, so constructed that it can be used for a single propeller

Fig. 2. An enthusiastic helper will be of great assistance in assembling the models and in winding the rubber motors.

1 bottle of cement
1 bottle of dope
2 sheets of wing covering
2 end hooks for single stick, if such models are entered
2 S-hooks
2 thrust bearings
6 washers for propeller assembly
2 spare propellers for each model entered, with shaft assembled
2 spare sets of pontoons
6 spare can hooks
1 spare wing for each model
1 spare elevator for each model
1 spare rudder for each model
2 spare nose hooks for each model
1 spare rubber motor for each model
1 bottle of rubber lubricant
1 spare landing gear for each R.O.G. model
1 razor blade
1 small-nose pliers
1 sharp pocketknife
1 piece spare bamboo
1 wire cutter

If your wings are of bamboo-tip construction, spare repair parts, made as shown in Fig. 3, should be carried. Such tips should be prepared at home to fit

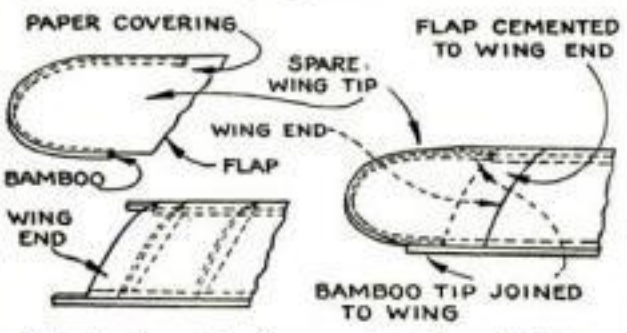


Fig. 3. A supply of spare wing tips will allow you to make repairs on the contest field.

the wings of the various models to be used in the contest. Have enough tissue overlapping the ends of the bamboo to allow it to be glued to the main wing.

In winding motors, be sure to stretch the rubber first and then wind (Fig. 2). Never wind your motor until actually called upon to compete, as the rubber, if allowed to stay at high tension very long, will lose its power.

The minute the flight is over, separate the rubber strands and dust them with talcum powder or cornstarch, which I have found to be even better. Rubbing a light coat of vaseline on the propeller washers and the landing wheel axles will greatly reduce friction.

On contest models, whether for endurance or speed, great care should be taken to obtain as tight a wing surface as possible. Spray the Japanese tissue with water after it has been applied to the wing but before any dope is used. Allow the wing to dry; then coat it with dope.

When starting an R.O.G. model in the ordinary way and especially under the exciting conditions of a contest, the hand holding the propeller often interferes with the plane and causes a poor start. Here is a tip which, with a little practice, will eliminate this trouble. Raise the tail of the model, as shown in Fig. 1, sufficiently to allow the tip of the propeller to touch the ground and hold it so. Then let go of the propeller, which will remain stationary, and hold the model only by the tail. The model will touch the ground at three points—the two wheels and the tip of the propeller. When the signal is given, drop the tail on the ground. This will release the propeller and start the model.

How to Typewrite Your Name Indelibly on Metal Tools

Fig. 1. The positive wire from the battery connects with the tool, while the negative wire connects with the copper plate.

By

KENNETH B. MURRAY

IMPOSSIBLE as it sounds, you can typewrite your name indelibly on metal. The method is so simple, practical, and inexpensive that for five or ten cents you can etch your name—and address, too, if you wish—on all of your tools. The lettering cannot be told from typewriting on paper; moreover, it will remain clear and legible for the life of the tool, or whatever metal surface the work is done on.

Obtain from a commercial stationery store a dry stencil sheet intended for making mimeograph stencils. Do the typing by the usual method, which is explained on the backing sheet attached to the stencil. Be sure that the typewriter ribbon is disengaged so that the bare type will strike the stencil, and see that the type is clean. On a clean-cut stencil depends the quality of the finished work. Cut off the part of the sheet on which you have typewritten, leaving a margin all around.

Next, cut a piece of sheet copper ¼ in. smaller than the stencil. Place this on a sheet of dry cardboard and on top of it put a sheet of clean, unprinted blotting paper. Mix a saturated solution of copper sulphate, which is made by carefully adding copper sulphate to water until no more will be dissolved. With an eye dropper, saturate the blotting paper (Fig. 2). Over this carefully lay the stencil so that the typewriting is reversed or reads backward (Fig. 3).

Now clean the tool carefully so that the flat surface to be etched is free from grease. Center it over the lettering on the stencil and press it into contact with the hands or a weight.

To supply current for the etching process, you may use a 6-volt automobile or radio storage battery. Connect wires from the battery to the tool and to the sheet copper by slipping the negative wire under the copper so as to make a good contact, and touching the positive wire to the tool. Hold the positive wire in contact for from two to five minutes (Fig. 1). Then disconnect the wires, remove the tool, and wipe it clean and dry.

If the contact between the stencil and the tool surface has been perfect, the metal will be etched with an exact reproduction of the typewritten matter, and the engraving will be of such depth that it will not wear off.

In etching more than one tool, the stencil should be watched carefully. It will last for a large number of impressions, but when the delicate lines are seen to be breaking away, a new stencil must be made.

Fig. 3. Placing the small stencil sheet over the wet blotter. The copper plate is on the bottom.

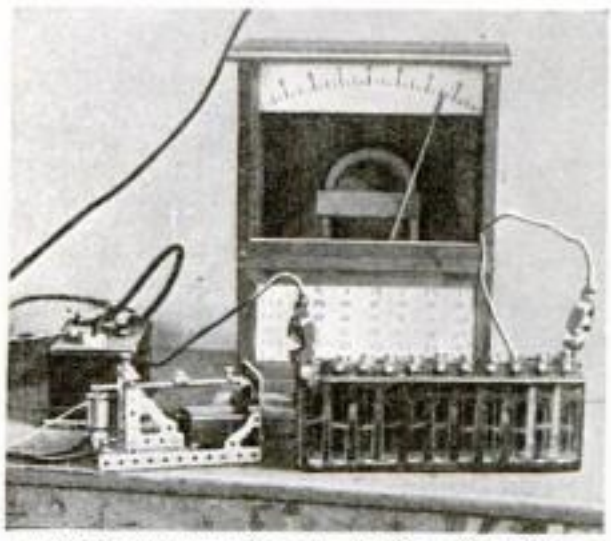
With this article, Mr. Murray submitted an excellent sample of three lines of single spaced typewriting on a piece of steel.

—THE EDITOR.

HOME WORKSHOP CHEMISTRY

DIRECT current electrical instruments usually require the terminals to be connected to the source of current in a definite relation, with due regard to the positive and negative wires. When wires are marked, the positive wire is usually red. If the wires are not marked, a chance reversal of connection will often destroy a costly instrument.

To find which is positive and which negative, connect a direct current voltmeter across the wires, if one is available, but do this only if the meter reads high



A D.C. ammeter, if connected in series with a suitable resistance, can be used to test polarity.

enough to cover the voltage delivered by the wires. A direct current ammeter also can be used, provided it is not connected directly across the wires but placed in series with a resistance.

When no meters are at hand, the positive and negative side of a system can be found by immersing a short length of the bare copper wires in a solution of table salt. The wire from which the greatest number of bubbles make their appearance is the negative side of the line. Even half of a freshly cut raw potato can be used if the bare ends of the copper wires (iron or other metal wires will not work) are inserted into the cut face of the potato at points as far apart as possible. The positive wire will be quickly surrounded by a greenish halo.

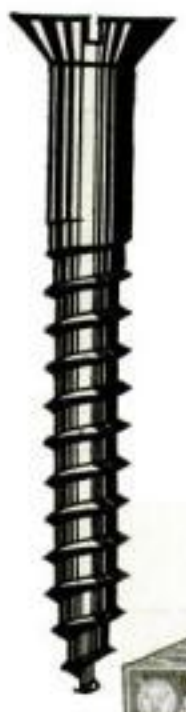
Blue litmus paper (paper used in testing for acid properties) also may be used. Moisten the paper and touch it with the two wires. Here the positive wire will turn the paper red at or near the point of contact.

For very weak currents, a solution of starch iodide is excellent; it will also serve to tell the polarity of strong currents. To make this solution, take a heaping teaspoon of cornstarch (wheat flour can also be used) and add ½ pt. of water. Heat until a uniform solution is obtained; then add a pinch of potassium iodide. To test for polarity, place a little of the thin paste on a glass plate or a shallow dish and insert the wires. The positive wire will be indicated by a deep blue coloration of the colorless starch iodide paste.—H. BADE.

Photo Morris Rosenfeld, N. Y.

Herreshoff Selected The Best Materials

WHEN the two beautiful racing yachts, the "Enterprise" and "Weetamoe," were under construction at the famous Herreshoff yard in Bristol, R. I., the greatest possible care was taken in the selection of materials. A weak spot would show up under racing strain and neither the owners nor the builder would knowingly take that chance.



When it came to selecting the kind of screws to be used on this important job, AMERICAN SCREWS—famous for almost a century—were ordered.

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Using a Lathe and Power Saw to Build an Oak Stool

By W. CLYDE LAMMEY

WITH the aid of a small lathe and power saw, the stool illustrated in Fig. 1 can be built and finished in a few hours. Though the piece is not an authentic reproduction in exact detail of that commonly known as the "English joint stool," it is sufficiently accurate to preserve all of the traditional utility and rugged simplicity of design which characterized that furniture period to which it belongs.

The top is built up from two 13/16 by 6 by 18 in. pieces of quarter-sawed white or red oak stock. Joint one edge of each piece square, and gage and bore three equally spaced 3/8-in. holes to a depth of 1½ in. in the square face of each. From 3/8-in. dowel stock, cut three dowels each 3 in. long; sharpen the ends and drive them in the holes in one piece. Spread glue on the joining edges of the pieces and clamp up with bar clamps.

Fig. 1. The completed piece has the rugged simplicity and utility of the "English joint stool."

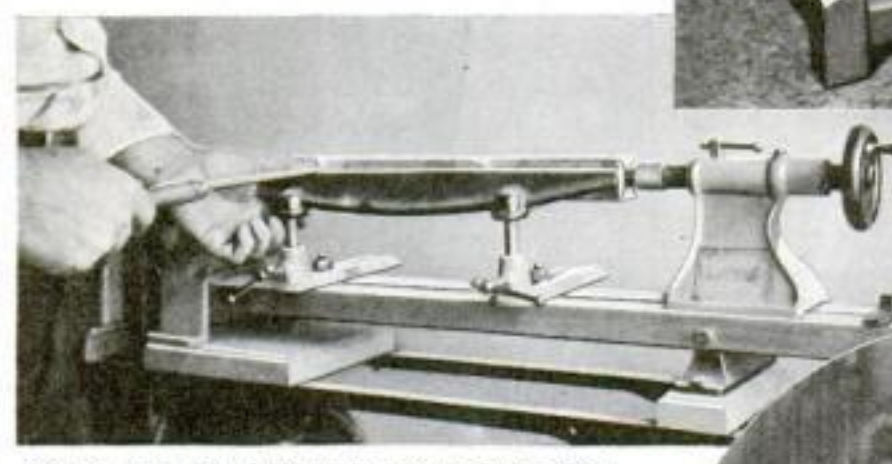


Fig. 2. A stool leg being turned in the lathe. The stock is left ¼ in. long and later cut to size.

From so-called 2 by 2 in. oak squares, which are usually 1¾ in. square, cut four pieces 18 in. long. The ends of the piece are later cut off at an angle of 3°, and the finished leg is reduced to a length of 17½ in. Accordingly, allow ¼ in. at each end for the angle and locate the turned portion as at *A*, Fig. 4. Leave the ends square until all four legs are turned (see Fig. 2). Sandpaper the turned portion of each leg before removing it from the lathe.

Fig. 3. Forming the molding on the top with a block plane. Note the four 1/16 in. deep grooves.

Set a T-bevel to an angle of 3° and mark both ends of each piece. Note that the angle is cut in the same direction at both ends. Set the crosscut guide of the saw to 3° and make the cuts on all four legs, being careful to get each exactly 17½ in. long.

Next, rip four pieces 15 in. long from 13/16-in. quarter-sawed oak stock, two pieces 4 in. wide, and two 1½ in. wide. From the same stock, rip two pieces 4 in. wide and 8⅞ in. long and two pieces 1½ in. wide and 10⅛ in.

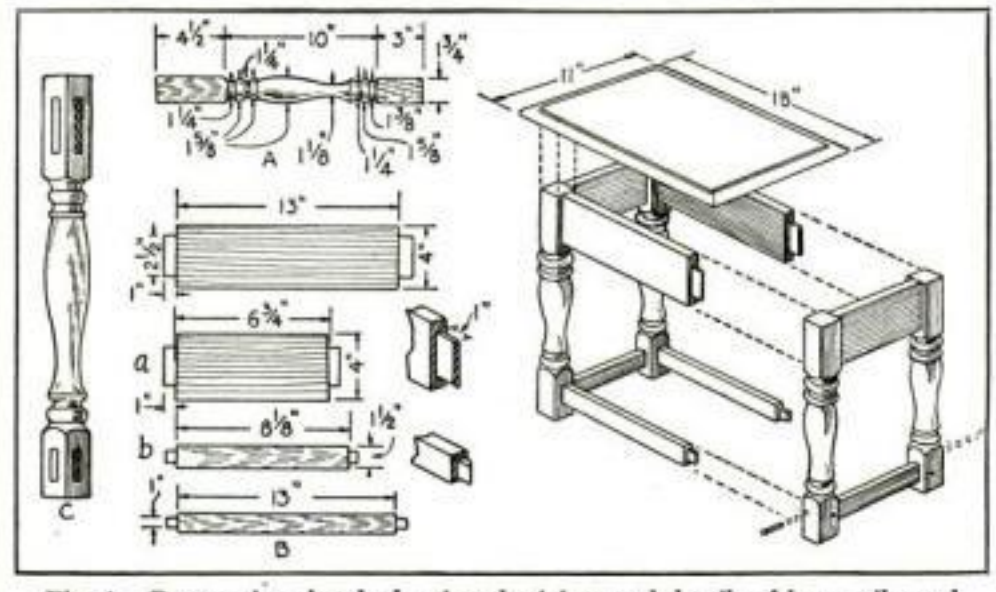


Fig. 4. Perspective sketch showing the joints and details of legs, rails, and beveled tenons. Legs and end rails are cut at an angle so as to flare the legs.

long. These form the eight rail pieces.

Take up the two wider pieces of the first four and gage ⅜ by 2½ by 1 in. tenons on both ends of each piece, the tenons being 1 in. long as at *B*, Fig. 4. On the two narrow pieces gage the tenons ⅜ by 1 by 1 in. Note that on the parts marked *a* and *b* the tenon shoulders are cut at an angle of 3°. Set the T-bevel accordingly and locate the shoulder gage lines on pieces *a* so that the distance between them at the center of the piece will be exactly 6¾ in. as indicated. Gage the tenons on the piece *b* in the same way with the shoulders at the same angle and the distance between 8⅛ in.

CAREFULLY set the dado head to make a cut exactly 1/32 in. deep and adjust the crosscut guide to the 90° position. Use the ripping guide set to 1 in. as a stop to insure the tenons being of exact length. Run the square-shouldered tenons on the four longer pieces first. Then reset the cross guide to 3° with the head, and cut the tenons accurately on the four shorter pieces.

Replace the saw blade, tilt the table to 45°, and miter the ends of the tenons on all pieces, making the miter cut parallel with the beveled shoulders of the tenons on the four shorter pieces. Then cut down the tenons to the widths indicated at *B* with a fine-toothed back or dovetail saw.

Lay out and gage corresponding mortises to fit the tenons of the respective pieces on two adjacent faces of each leg, as at *C*, Fig. 4. Remember the beveled ends of the leg when laying out the mortises; make sure before boring that the latter are correctly located.

USING a bit with a stop set to 1 in., bore a series of ⅜-in. holes for each mortise, and chisel the sides square. Make a trial assembly of each tenon in its respective mortise, trimming the parts if necessary to insure a close fit. This done, glue all joints and draw the parts together with several bar clamps, making sure that the frame is square. Peg the lower joints all around, using ⅜-in. dowels for pegs.

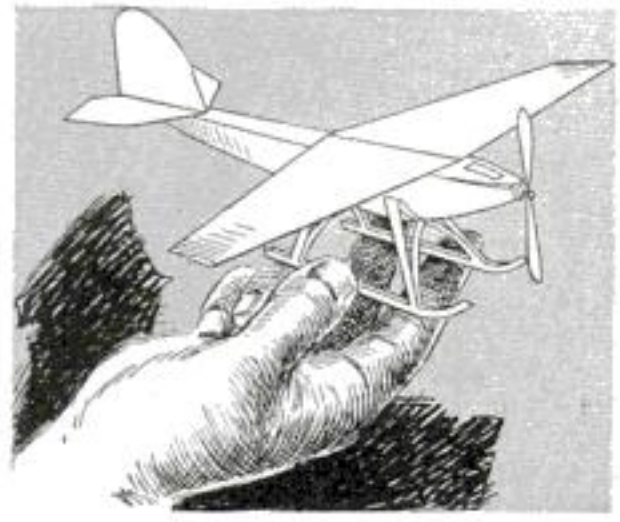
Plane the top to a width of 11 in. and see that the ends are true and square with the sides. Set the dado to cut a groove 3/16 in. deep and ⅜ in. wide and bring up the ripping fence to 1 in., measuring from the outside edges of the head to the face of the guide. Then set the top board face down on the saw table and run a groove down the sides and across the ends, using the ripping fence as a guide. Set the work in the vise and plane the edges to a rounding contour with a sharp block plane (see Fig. 3).

Locate accurately and lock the top to the frame of the stool with screws, driving these up through slanting holes bored in the top edges of the rails, and lastly driving a dome or sliding caster into each leg.

Carefully sandpaper all parts, finishing with fine grit. Blow off the dust and brush on a dark oak oil stain. Wipe quickly to bring out the grain of the wood. Allow the stain to dry and fill the grain with a dark oak paste filler. Sand lightly with fine paper and apply two coats of white shellac. Rub down the last coat and finish with furniture wax.

Midget Rise-Off-Ground Plane Made of Writing Paper

By JACK HAZZARD



Motor and propeller are the only parts not made from ordinary correspondence paper.

HERE is a midget model plane that looks and flies like the real thing, will rise off the ground, and will stand collisions which would wreck the ordinary model aircraft, yet practically the whole structure is made from ordinary bond correspondence paper of from 16 to 20 lb. weight.

After cutting the fuselage to the shape indicated, roll the paper tightly around a pencil and hold it for a minute or so. This will help materially in bringing the edges together and gluing them.

The three projections forming the streamlined front are brought together and glued, and for an inch or so back of the nose the fuselage is sized with glue to add stiffness. One of the quick-drying cements serves best.

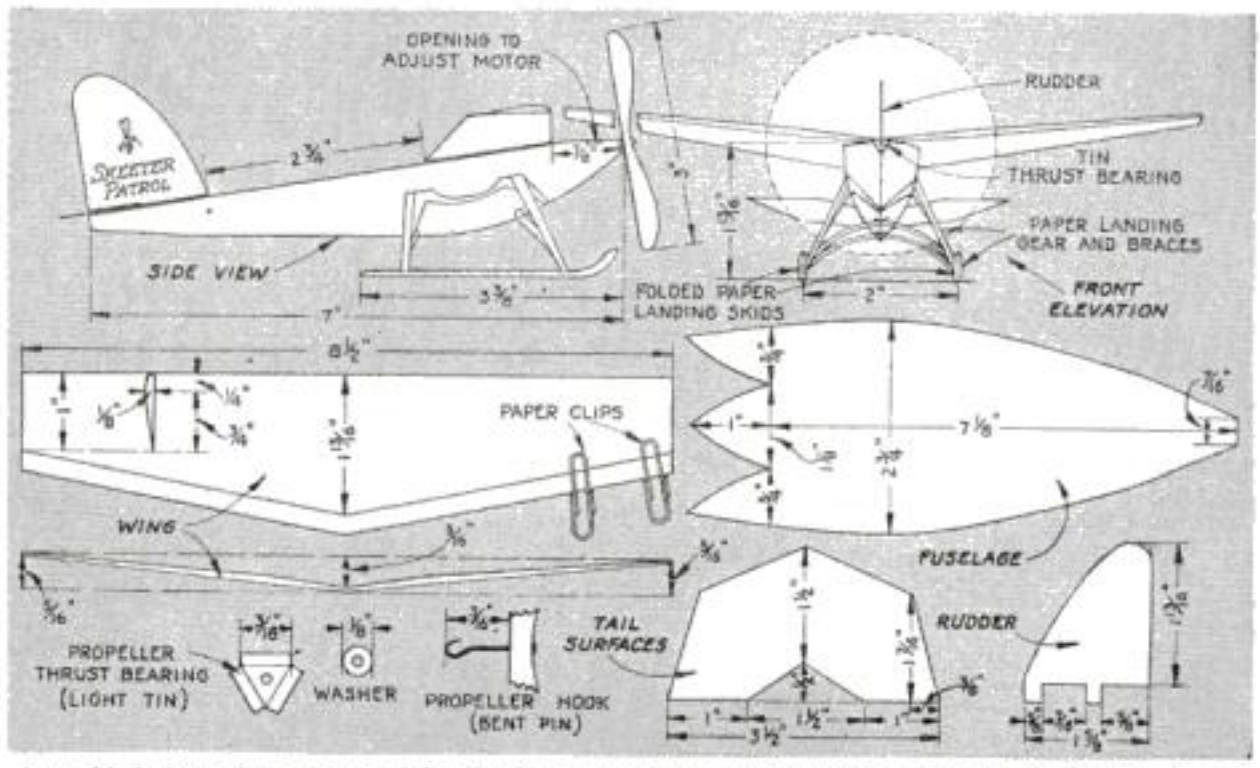
Cut a small triangle of light tin, snip off the corners, and bend the edges back to the line of the fuselage to form the bearing, which when completed should not measure more than 3/16 in. on a side. With a razor blade cut off the sharp tip of the fuselage so that the bearing will fit flush. Be careful to set the bearing squarely at right angles to the center line of the plane.

Cut a sheet of paper to give a wing of the dimensions indicated. To obtain the camber, which materially stiffens the construction, makes the wing more efficient, and adds to the realistic appearance of the ship, crease the paper along the front edge of the wing, coat the trailing edge of the top surface with glue, push it slightly forward until sufficient camber is obtained, and clamp it in place with paper clips until the glue hardens.

Next, cut out and attach the tail surfaces, taking pains not to crease or bend them.

The propeller is cut from a small bit of white pine or balsa wood, 1/4 by 5/16 by 3 in., the latter being preferred. Pierce the center of the block with a pin before cutting it to shape. Then pull the pin out and save it to use later for the propeller hook.

To insert the motor, which is a double strand of 1/32 in. square rubber, cut a 1/8 by 3/8 in. slit just back of the thrust bearing. Through this insert the motor by holding it on a hooked wire, and run it to the tail of the plane, where a pin is pushed through the fuselage and the end loop of the rubber. Cut the pin off short and secure it with a drop of glue at each end. The motor should be taut but not



Assembled views of the plane and details of the wing, fuselage, tail surfaces, and propeller bearing. Small wheels or pontoons made from shellacked bond paper can be used instead of landing skids if desired.

stretched when engaged with the hook.

Run a little glue along the center of the horizontal tail surface and glue it on top of the fuselage. Spread the tabs on the rudder at right angles to the rudder, coat them with glue, and place the rudder perpendicularly along the center line of the horizontal tail surface.

Fasten the wing to the body of the plane experimentally with two small drops of glue, being careful that its leading edge forms a perfect right angle with the center line of the plane. If the wing is not fastened permanently at first, the balance and gliding angle can be controlled by moving it very slightly forward or aft.

The ship now begins to look businesslike, but needs a landing gear. If desired, small wheels or floats can be made of shellacked paper, but skids of folded paper as shown in the drawings serve very satisfactorily for all practical purposes. They are little troughs of paper, shellacked or sized with glue to add stiffness. The struts may be either cut and folded from one piece or built up.

If the whole plane is given a coat of shellac, it will be stiffer and last longer, but it will not fly so far or so strongly.

If a stronger rubber motor is placed in the plane, it can be made to stunt, but the high tension on the paper fuselage will result in buckling in a short time.

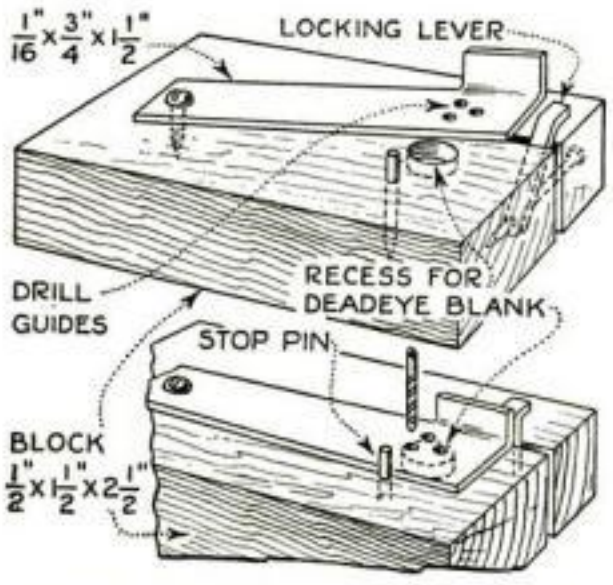
Two photographs accompanying Mr. Hazzard's article showed the model in flight, but they were unfortunately too small to be reproduced.—THE EDITOR.

JIG SPEEDS UP DRILLING OF MODEL DEADEYES

WITH the aid of the drilling jig illustrated, the writer drilled all of the deadeyes for a large ship model in less than one hour.

A ½ by 1½ by 2½ in. piece of soft wood was used for the base, and a hole, large enough to receive the deadeye blank, was drilled in one end.

The drilling guide, formed from a 1/16 by ¾ by 1½ in. piece of brass, was put in place before being drilled. A small piece of metal cut to the shape of an angle was used as a locking lever to hold the guide in place over the deadeye blank. A stop, made from a small nail, was placed on the opposite side.—JAMES J. DOYLE.



Top view: The jig open ready to receive the deadeye blank. *Bottom view:* The jig closed.

THE SHIPSHAPE HOME

Upholstery Repairs for Beginners

IN A LARGE number of cases the bottom of upholstered furniture gives way before the top covering is worn out. This may be due to an inferior grade of webbing which could not support the strain, or the tacks may have been too small or too few in number to fasten the webbing to the frame (see Fig. 1).

How should the bottom be replaced?

To replace the bottom by removing the top covering would be a difficult problem

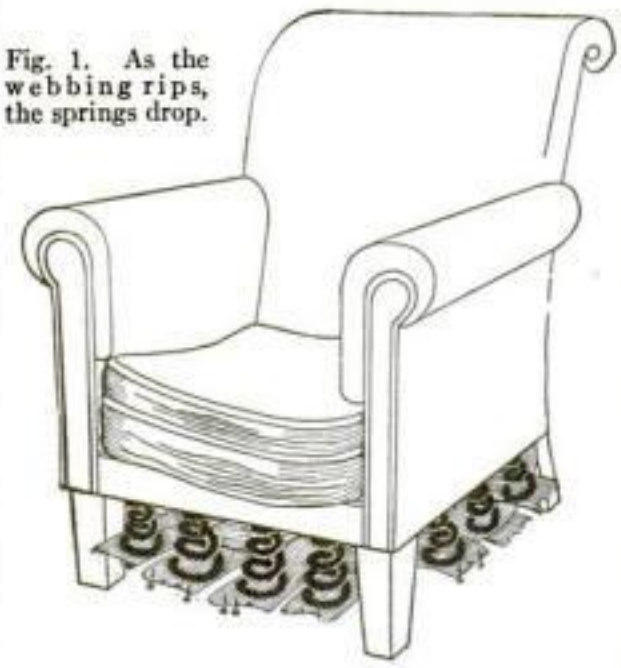


Fig. 1. As the webbing rips, the springs drop.

even for an experienced upholsterer, as the covering probably would be torn. This problem may be solved by repairing the seat from the bottom.

What are the steps in making this repair?

1. Turn the piece of furniture bottom side up and remove all webbing and tacks from the bottom of the frame.
2. Tie the springs as shown in Fig. 2. This will

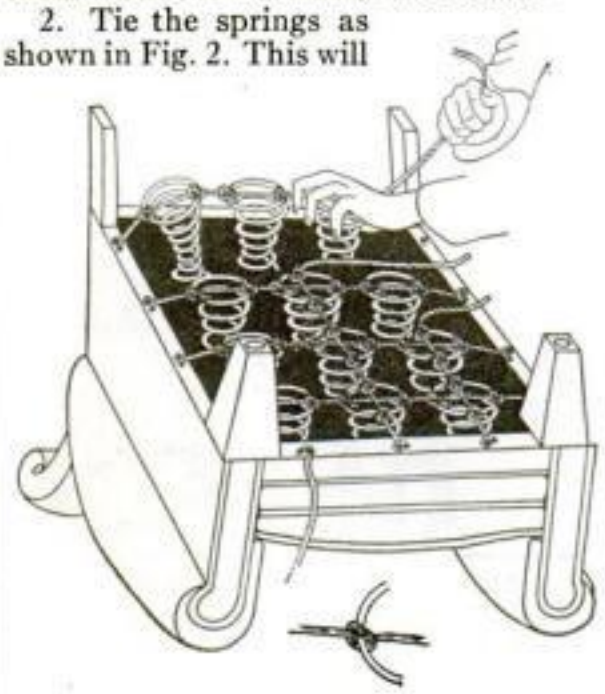


Fig. 2. The springs must be tied up in order to prevent them from shifting or falling over.

prevent them from shifting or falling over to one side or the other.

3. Stretch new strips of webbing directly over each row of springs as shown

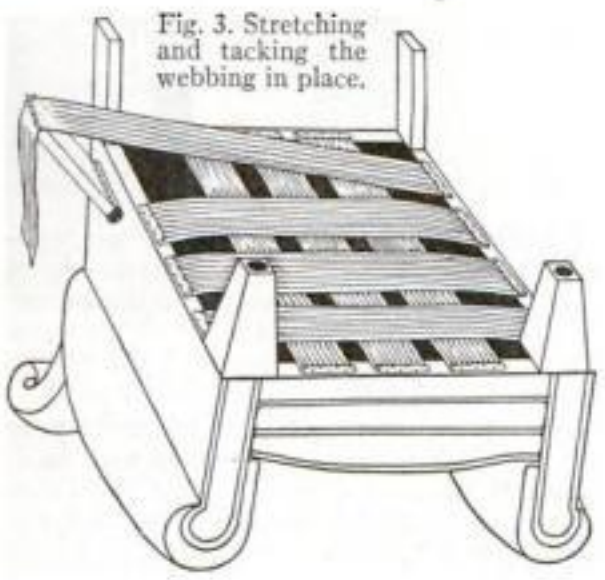


Fig. 3. Stretching and tacking the webbing in place.

in Fig. 3 by means of a webbing stretcher (see the next question and answer). This will force the seat covering back to its normal position as indicated in Fig. 4.

4. Tack a piece of black cambric over the webbing; this will prevent dust from falling to the floor.

Fig. 4. The seat restored to service.

How is a webbing stretcher made?

By the method shown in Fig. 5. Drive five nails into the end of a piece of wood 4 by 7 in., letting them project about 1 in. Cut off the nailheads and file the nails to a point. To prevent marring any exposed and finished woodwork and to keep the stretcher from slipping, tack a piece of cloth or rubber on the other end of the block—the end that is placed against the frame.

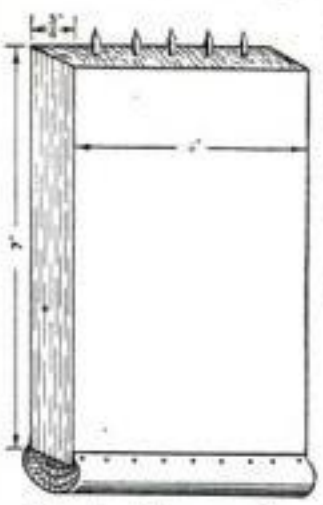


Fig. 5. A homemade webbing stretcher.

The strecher can be made a little easier to grasp if a large arc is cut in each of the long edges to remove some of the surplus wood. Round all the sharp corners. —HERBERT BAST.

Outside painting problems will be discussed in the Shipshape Home next month.

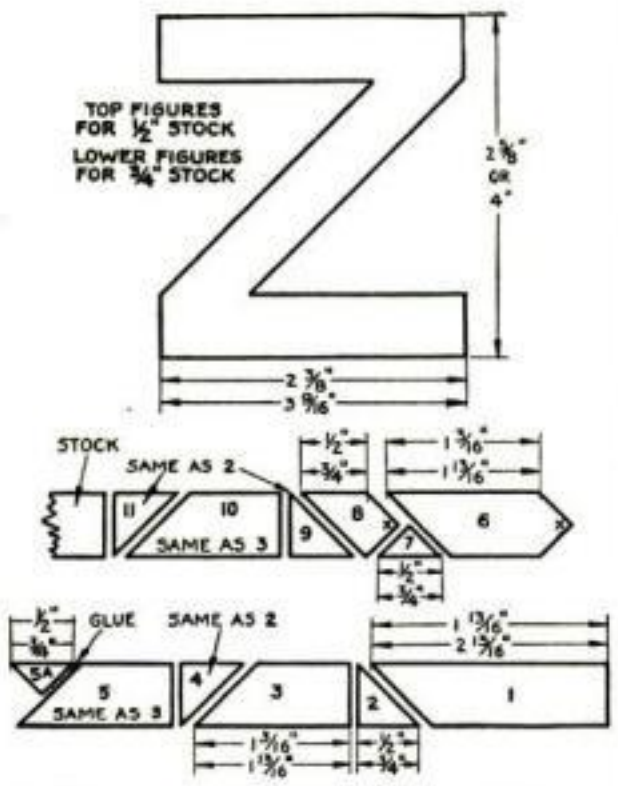
OPENING FRUIT JARS

TO TURN a tight fruit jar cap, run a wide rubber band around it and another around the base of the jar, at the points where you grip each. The bands hold these surfaces like a pipe wrench and, at the same time, form a soft, nonslipping contact with your hands. In the absence of wide rubber bands, small ones, or any other scrap rubber such as part of an old rubber apron, will serve.—WORTH STEWART.

Can You Fit These Blocks Together?

YOU will find them easier than you think—perhaps. At any rate, even if you are able to solve these two new block puzzles without difficulty because of the experience gained with previous puzzles in this series, your friends will have a good deal of fun trying to work out the solutions. It will not be a simple matter for them.

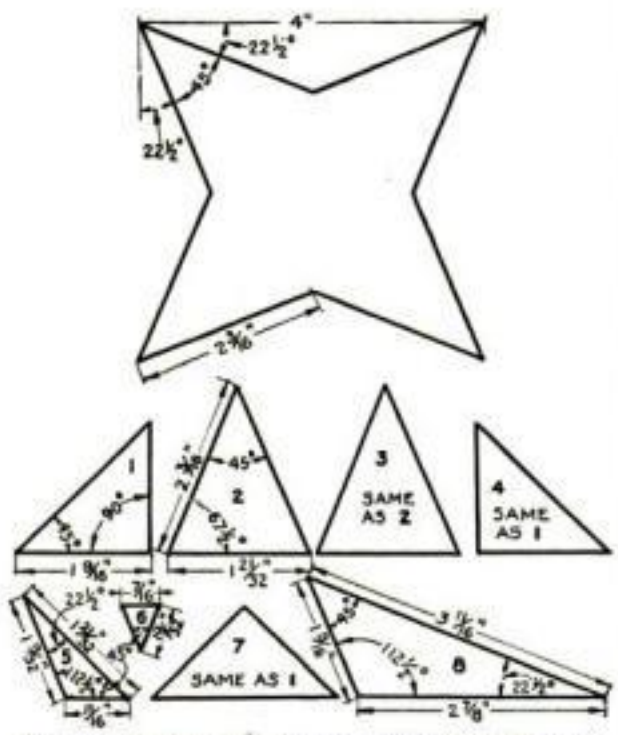
The four-point star puzzle may be made from thick cardboard, wall board, or wood



A full size pattern will prove a great help in solving both this puzzle and the one below.

up to ¼ in. thick. If the eight pieces are cut exactly to the measurements given, they will fit perfectly into the outline of the star, which should be drawn full size as an aid in solving the puzzle.

To lay out the diagram of the star, first draw a 4-in. square and from each corner draw lines at an angle of 22½° to the sides of the square. When the star has been outlined in pencil, it can be inked in and the construction lines erased. A protractor will aid in laying out the an-



The parts for the star puzzle must be cut separately, all angles being carefully laid out.

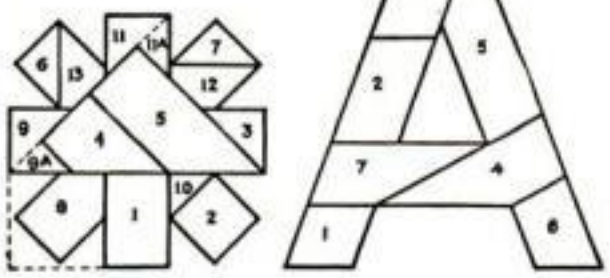
A definite program for getting ahead financially will be found on page four of this issue.

gles, although obviously a template can be made for drawing the lines merely by folding a square piece of paper accurately on the diagonal to form a 45° triangle and then folding again to make a 22½° triangle.

Whatever method is used, mark the angles for the eight pieces as carefully as possible, cut them out, and then try to fill the outline of the star.

The letter Z puzzle is made in the same manner as previous block puzzles in this series (P. S. M., Feb. '30, p. 117; Mar. '30, p. 133; July '30, p. 117; and Aug. '30, p. 98). Cut the eleven pieces from the stock in the order given. The upper

Did you solve the August puzzles? Here are the solutions.



or shorter measurement in each case is for stock ½ in. wide and the lower or longer one, for stock ¾ in. wide.

All the cuts are made at either 45° or 90°, and the blocks are all shown the right side up for obtaining the correct solution. After sawing off pieces *5A* and *7*, the point marked *X* on pieces *6* and *8* must be recentered. As in the star puzzle, it is of considerable help to draw the letters full size, being sure to use the dimensions corresponding to the width of stock used.

The solutions published this month are for the two puzzles described in the August issue.—ERIC B. ROBERTS.

BOTTLE OPENER APPLIED TO KITCHEN TABLE

BESIDES being convenient to use, a bottle opener attached to the kitchen table as illustrated has two advantages. It allows considerable leverage to be exerted and only one hand is required to manipulate the bottle, the other being free to hold the glass. In the old way, whenever a bottle is opened that contains a liquid under pressure—for instance, ginger ale—some of the liquid may overflow before the bottle opener can be laid down and the glass picked up.

The opener is attached under the table top.

To adopt this idea, choose an opener that will allow it to be attached beneath the table by means of a strap having a screw in the center. Then the opener can be swung out of the way under the table top when not needed. —ALICE MOORE.

Small Pack Mule Carries Burden of Cigarettes

By CONRAD A. CONLEY
and FRANK L. WADE

Instructors in the Brewster Vocational School, Tampa, Florida

THOSE who have lived in or visited the Southwest will recognize at once what the cigarette novelty in Fig. 1 represents—a heavily laden pack mule plodding along a wilderness trail.

The mule itself consists of the five pieces shown in Fig. 2. These are cut from ⅜ in. thick plywood. Pieces *A* and *B*, which form the center section of the body, are

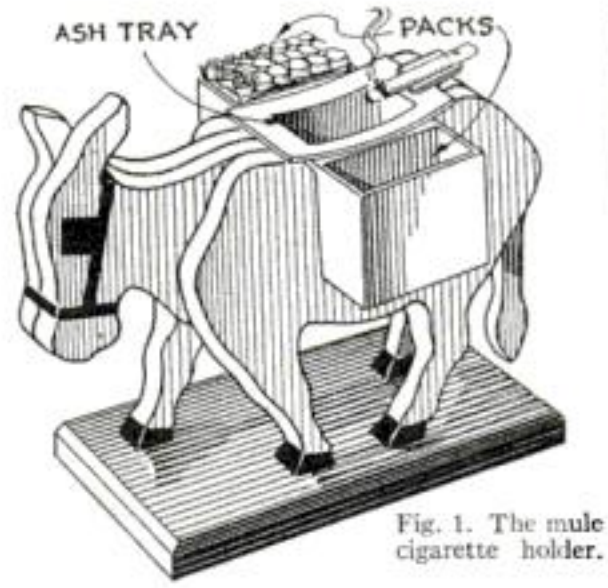


Fig. 1. The mule cigarette holder.

fastened together with ⅝-in. brads, nailed in from each side, after the tail *C* has been inserted in the mortised slots provided for it in *A* and *B*. Parts *D* and *E* then are nailed on their respective sides of the center section.

The body is glued and nailed to a base ½ by 3 by 7 in. with the top edges chamfered. Brads 1 in. long are used; they are driven from the underside of the base up into the feet.

It is well to paint mule and base before the packs and ash tray are attached. For this purpose brushing lacquer or quick

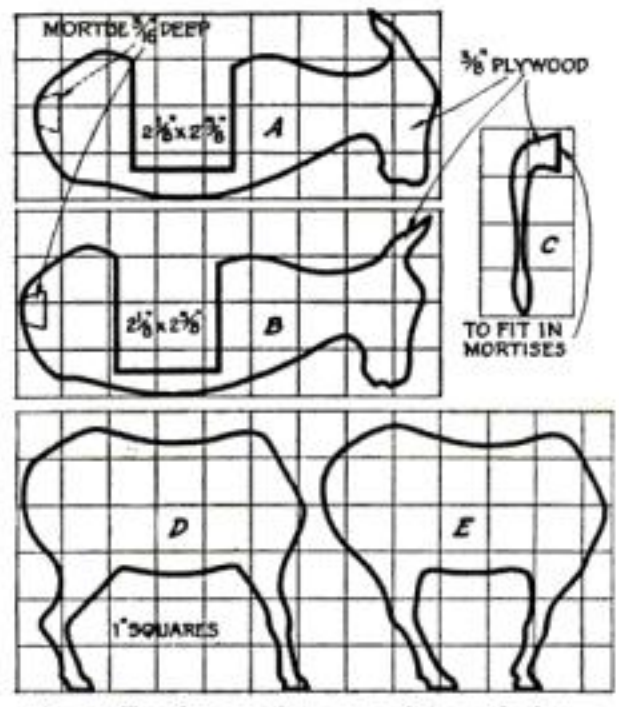


Fig. 2. The five wooden parts of the mule drawn on 1-in. squares to allow easy enlargement.

A definite program for getting ahead financially will be found on page four of this issue.

drying enamel is recommended. An effective color scheme is as follows: For the entire body and the edges of the base, French gray; for the upper surface of the base and the packs, saddle, and pommel, dark green; for the hoofs and halter, light brown.

In constructing the two packs, the ash tray, the saddle, and the pommel or cigarette rest, any lightweight tin will answer. Empty coffee cans are suitable.

First cut out the various pieces from the tin as shown in Fig. 3 and fold on the light lines. There is a ⅛-in. hem (or lap)

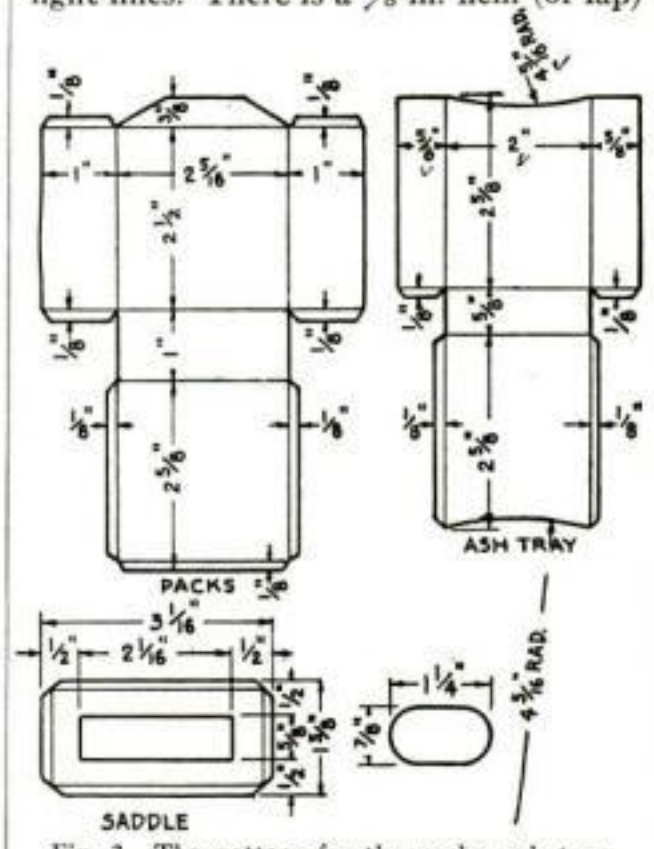


Fig. 3. The pattern for the packs, ash tray, saddle, and cigarette rest. The last is bent concave and soldered to the saddle like a pommel.

around three sides of the top edge of each pack; this hem is folded to come on the inside of the pack. The fourth side has a ⅜-in. lip, which is bent at right angles toward the outside so that it can be tacked to the mule's back. All the seams must be neatly soldered.

The ash tray is made ⅛ in. smaller than the opening formed in the parts *A* and *B* of Fig. 2 so that it may be easily removed for emptying.

The saddle has a ⅛-in. hem around all four sides. It should be soldered to the ash tray with the opening directly in line with the mouth of the tray. The pommel is soldered, concave side up, to one end of the saddle.

When completed, each pack will hold a full package of twenty cigarettes.

HOW TO CUT OFF A BOLT

WHEN a small bolt or machine screw has to be cut shorter, as often happens, it is a good idea to screw the nut on the bolt before doing the cutting. Afterwards, when the nut is unscrewed, it will act as a die and smooth the ragged threads at the end, making the bolt easier to handle.—RAYMOND B. WAILES.

Machine screw with nut ready to be cut off with the hack saw.

Making an Electric Popper for Corn

By CHARLES M. RICE

IF YOU wish to own an efficient and inexpensive electric popcorn popper that compares very well in performance and appearance with the commercial type, you will no doubt enjoy making the project described in this article.

The materials for the popper, most of which can be purchased at any "ten-and-fifteen-cent" or hardware store, are as follows: aluminum saucepan (6 in. in diameter at the bottom), tin pie plate (6 in. diameter at the top), cover to fit saucepan, small wooden knob for cover, sheet of asbestos board, two pieces of asbestos paper, large wooden handle for saucepan, ⅛-in. wire for legs, and 20 ft. of No. 22 nichrome element wire. The

Few tools and materials are needed in the construction of this inexpensive corn popper.

latter perhaps can be salvaged from some old heating element. The parts can be obtained for approximately sixty-five cents.

In constructing the element, obtain a piece of ⅛ in. diameter welding or other rod and wrap about twelve turns of the element wire around it near one end. Place the small coil thus made, with the rod inside, between two blocks of hardwood and squeeze it in a vise just enough to form the impression of threads in the wood. Fasten a hand brace to the end of the rod and turn it slowly, feeding the wire in until the coil is completed. The assistance of a second person is needed when making the coil in order to prevent the wire from kinking. Stretch the coil so that the turns are opened slightly.

Cut a 4½ in. diameter disk from a piece of asbestos board or slate and arrange the coil in a zigzag formation on the asbestos disk, keeping it well within the boundaries of the circle. The coil is fastened in position with short lengths of nichrome wire passed through holes drilled in the board.

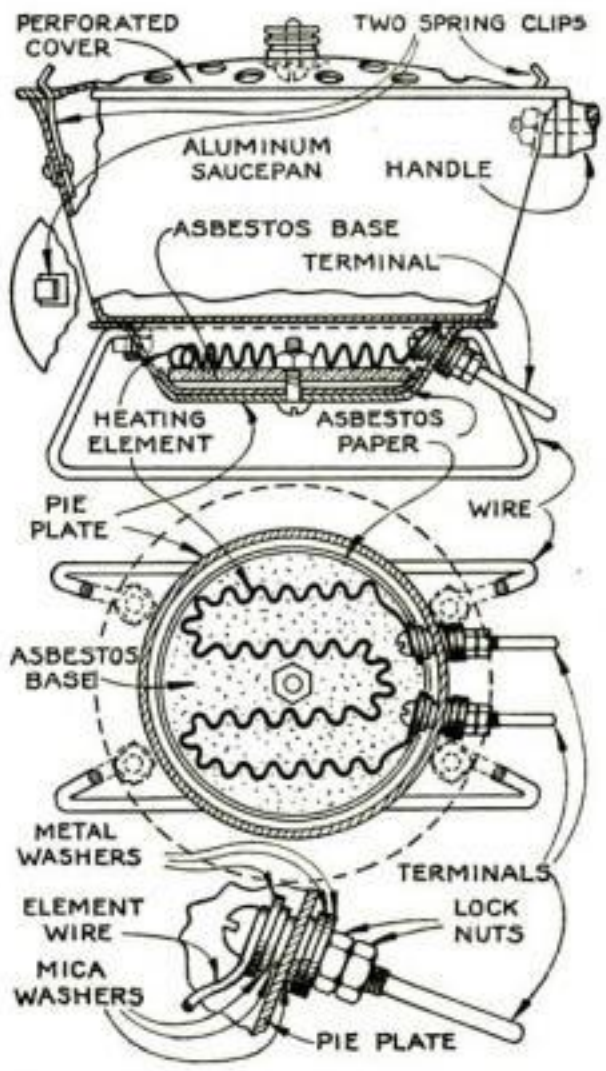
Drill two ⅜-in. holes ¾ in. between centers in the side of the pie plate as shown for the two 3/16-in. stove bolts 1½ in. long, which serve as the terminals. When fitting each terminal, be sure to use metal washers on the inside and outside, at the same time placing the mica washers between the metal washers and the sheet metal of the plate. Small mica washers are used around the bolts, inside the holes in the plate, to keep the bolts clear of the metal. The threads on these bolts should be cut down slightly with a file to allow the appliance plug to be slipped on.

After placing a piece of asbestos paper

on the plate, fasten the asbestos board in place with a small machine screw, and place another piece of asbestos paper over the element for protection.

Drill four 1/32-in. holes through the rim of the pie plate and, using the plate as a template, locate and drill four holes in the bottom of the aluminum saucepan. Bend two pieces of wire or 1/8-in. welding rod into shape for the legs. Eyes are formed at each end of these pieces to fit over the 3/16-in. machine screws which hold the parts of the popper together.

A substantial handle for the saucepan can be made from a wooden file handle



Sectional view of completed popper and details of element and terminal construction.

drilled to take a piece of 1/4-in. rod stock threaded at both ends. Place the rod through the handle, as well as through the hole drilled near the top of the aluminum pan, and tighten the nuts on the rod. It is well to use a fair sized disk of sheet metal inside the pan where the rod enters in order to reënforce the thin aluminum.

The holes in the tin cover can be punched with the shank of a 3/8-in. drill. This is best done with the aid of a steel die made by drilling a 3/8-in. hole in a piece of stock. The shank of the drill should be ground on the emery wheel until it is flat before using it as a punch.

To use the popcorn popper, plug it in the 110-volt lighting circuit and place enough popcorn in the saucepan to cover the bottom. Shake the popper with a moderately slow motion until the corn begins to pop, at which time the motion should become vigorous, thus keeping the unpopped kernels on the bottom and forcing the fluffy kernels to the top. The plug may be withdrawn before all the kernels are popped, since enough heat will remain to finish the popping action.

The writer wishes to acknowledge the assistance given by E. T. Williams in designing and constructing the element.

You, Too, Can Build This Doll's House

An unusually well-finished doll's house constructed with the aid of our Blueprint No. 72.

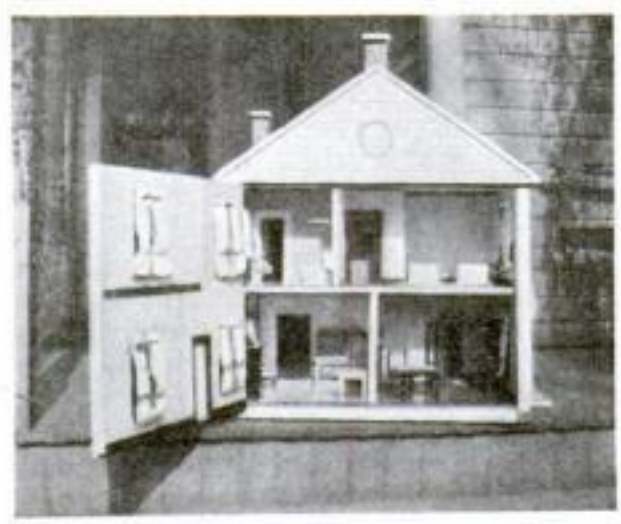
IF YOU know some little girl who would appreciate such a complete and altogether "playable" doll's house as this, there is just one way you can give her one—build it yourself. POPULAR SCIENCE MONTHLY Blueprint No. 72 (see page 103) will provide all the necessary drawings, and Blueprint No. 73 gives full size drawings for toy furniture for the house.

It was Blueprint No. 72 which helped Melville H. Hollis, of Fort Wayne, Ind., construct the exceptionally well-finished and beautifully decorated house pictured in this column. In sending these views, he wrote:

The siding is made of strips ¾ in. wide, ⅛ in. thick, and 3 ft. long, tapered like real siding. The shingles are cardboard cut in strips like regular asphalt shingles and glued to the ¼-in. plywood roof.

The floors downstairs are ⅜ by ¾ in. oak strips nailed to a piece of ½-in. plywood. All the doors are of 5/16 in. thick walnut. The French door and front door have glass in them and swing on small brass hinges. The interior woodwork and stairs also are walnut.

My wife made tie-back curtains for all the rooms. We bought the bathroom fixtures, but



Both ends of the house can be opened and the top raised to give access to all the rooms.

as we couldn't get a tub that looked right, we made one from plaster of Paris, enameled white.

The kitchen was carried out in green with small checked shelf oilcloth in green and white.

Those who wish to make this type of doll's house will find the work easier if they take advantage of the information contained in Blueprints Nos. 72 and 73.

Gliding Made My Flying Better

(*Continued from page 37*)

is what keeps a soaring plane on the ground."

We had returned to the wind-winged, white soaring ship poised on the ridge top.

"Where do I go after I reach the 'chimney'?" I wanted to know.

"Circle in the air column and try to gain enough height to cruise back here for a landing."

"And if I don't?"

"Then you will have to land in the valley again, unless you can pick up additional height on the windward slope of a further ridge."

On my first flight, I had used only one up-current, that directly in front of the ridge from which I started. This time, I was to cruise from one rising current to another—if I could.

By soaring from up-draft to up-draft, in this manner, the sailplane pilots of Germany have made long flights across country. The Austrian ace, Kronfeld, traveled nearly 100 miles in a straight-line distance on such a trip. These pilots take off from the top of Mount Wasserkuppe, at an altitude of nearly 2,000 feet, and fly across the rolling country of central Germany, sometimes heading for ridges so distant they have to steer for them by compass.

I CLIMBED into the streamlined cockpit in front of the great white wing. There is no safety strap to hold a pilot in his seat in a soaring plane. I asked Bowlus why.

"You don't need one," he answered, "because there are no bumps in soaring."

An airplane or a heavy primary glider passes through an up-current more quickly than a sailplane. These machines rise and drop suddenly. The pilot gets a jolt. But in a featherweight soaring craft, weighing less per square foot of supporting surface than a sea gull, the whole machine ascends and descends gently on the varying air currents.

The launching crew had taken their places on the shock cord, or rubber cable which is stretched out to shoot the machine into the air. Bowlus attached the apex of the "V" it formed to the nose of the glider. My hand was on the stick; my feet on the rudder pedals. I looked around. The fog had cleared. A midday sun was blazing in the sky.

"That will strengthen the up-currents," Bowlus told me.

"How's that?"

"When the sun beats down on the slope of a ridge," he explained, "the air near the ground is warmed and rises. This adds to the strength of the up-drafts created by the wind striking the slope."

SOME years ago, such heated air, or "thermic up-currents," saved the day at a soaring meet on the coast of France, near Cherbourg. When the sun beat down upon a sandy beach, some 300 feet wide, which separated the dunes from the sea, the air above shimmered and the power of the dune-made up-currents was noticeably increased. As soon as the sun went down in the evening, the strength of these up-drafts lessened, even when the velocity of the breeze remained the same. Often when the soaring ships landed on the beach in the daytime, I am told, they would sail for as much as two miles, floating a few feet above the sand, supported by the heat waves.

Over the Sahara Desert, the strongest heat waves are found. In 1923, French soaring pilots made a series of amazing "hot air" flights near Biskra, Algeria. One machine rode the heated air to a height of over 1,000 feet, and another motorless plane floated for seven hours above the desert sands.

Bowlus had walked to the brow of the ridge. He was holding up his handkerchief. It showed that the breeze had veered slightly. The members of the launching crew altered their position, pointing the ship directly into the teeth of the wind. Otherwise, it would have been shot off with the gusts striking it from one side, increasing the difficulty of control. I looked out toward the tip of each wing to be sure everyone was clear. Severe injuries may result from being struck by a wing during launching. Then I gave the starting signal: "One! Two! Three! Run!"

The launching crew sprinted forward. The huge "V" of five-eighth-inch shock cord lengthened. The machine shot ahead. In less than a dozen feet, I was in the air.

The cord dropped from the hook at the nose of the plane. The whistling of wind past the wings died down. I soared out over the crest of the ridge. Ahead, and far below, lay the boulders, the telephone wires, and the waters of Long Island Sound which had caused me anxiety on my first flight (P. S. M., Aug. '30, p. 36).

As the ship cleared the ridge, my left foot moved forward an inch or so; my hand edged over the stick in the same direction. Instantly the long-winged machine nosed to the left in a shallow bank. It skidded outward toward the rising air a hundred feet away.

I WAS leaning back comfortably in my seat. The tenseness, the strangeness of flying "with the motor stopped", had passed. I could study the effect of different movements of the controls. For instance, I noticed that quick movements of the stick in bringing down the high wing on entering rising air resulted in loss of altitude. Compared to a high-powered airplane, the movement of the stick on a soaring ship seem like slow motion pictures.

With the forward wing high, we skidded into the up-currents. The plane ballooned upward. The slope and the launching crew dropped away. This time, the lifting currents were far stronger than on my first flight. I rocked the stick slowly to the right. The high wing swung down. We straightened out on our course. On wide white wings, I coasted down the slope following the line of rising air. It was like cruising on a river that was moving upward.

I neared the V-formation and the powerful currents above it. I began to turn—a trifle too late. The path of the ship curved upward as the hard gusts struck the wings. Then it flattened out. I had swung too far. My circle had taken me beyond the rising air column. I had gained only a slight amount of altitude. I was too low to glide back to the starting point.

IF I turned sharply to get back into the up-column, I would lose more height than I could gain. My only chance to keep from landing among the boulders of the valley was to reach the up-currents above a third ridge to the southwest. I headed for it at the flattest possible gliding angle.

Before the start, Bowlus had warned me:

"If you go on to another ridge, watch out for the down-currents on the lee side. The wind follows the contour of a hill, ascending on the windward side and descending on the lee side. If you get caught in the down-draft and begin to sink, don't lift the nose, whatever you do."

"Why?"

"You will stall, sure."

"How far will I drop?"

"Twenty feet or so. A stall in a soaring plane isn't as serious as one in an airplane. But you lose altitude that is hard to regain."

Just before I reached the ridge, the ship began to settle. It lost altitude at an alarming rate. I wanted to pull up the nose to a flatter gliding angle in an attempt to save height. But I remembered Bowlus' advice:

"Fly through (*Continued on page 123*)

Gliding Made My Flying Better

(Continued from page 122)

descending air straight as fast as you can."

I held the rudder steady and eased the stick ahead. The nose dropped. The speed increased. We scudded low over the ridge into the rising air beyond. By sheer luck, I wheeled into the up-drafts just where they were strongest. The wings creaked as the sailplane soared aloft. I swung in a half-circle and the ridge slipped under my wings as I headed back for the V-formation.

THIS time, I took no chances. I kicked over the rudder and skidded sidewise into the air driving vertically above it. The ship seemed rising skyward on an elevator. I knew then I would get back to my starting point. Again I followed the upward moving river of air along the slope, picking my way down the ridge. I could see the launching crew waving their hats. I swung in a wide arc over the brow of the ridge, headed into the wind, and pointed down the nose for a landing.

The instant the ship touched, I shoved ahead the stick. I had learned my lesson from my first "rabbit" landing in which I had made half a dozen hops across the ground before I could get the ship to "stay put." We slid barely fifteen feet and came to a stop.

The launching crew was giving a big cheer. "They always do when you land at the starting point. They don't have to drag the ship up the hill," Bowlus laughed.

Soon after that, the wind began to die down and our soaring expedition was over.

Probably the most dangerous type of gliding is that in which the ship is towed behind a powered vehicle. A few months ago, I made such a flight for more than a mile across Curtiss Field, Long Island. When I was 150 feet in the air, an unexpected accident gave me a couple of thrill-packed minutes.

The towrope was fastened to the hook of the glider by a metal ring. A cord, which I held in my hand, kept the ring on the hook. When I wanted to cut loose from the towing auto, I was to lift the nose and let go the string, allowing the ring to drop away. We were nearing the far end of the field, when I nosed up the ship and let go of the cord. Nothing happened. The ring was stuck on the hook. I wabbled the stick, trying to shake it loose. Still it stuck. I squirmed around like a cat over water, in an attempt to kick it loose. No good. The auto had almost reached the boundary fence. As a last resort, I pulled the stick clear back against my chest. The ship zoomed, stood on its tail, and stalled. The towrope fell away. We hung for a second or two, then plunged nose down for twenty or thirty feet before regaining flying speed. An airplane, stalled at that altitude, would have buried itself in the ground.

SPECIAL precautions must be taken in auto towing. A pilot must be careful not to climb too steeply when the driver of the auto is speeding up. Sudden pressure on the wings might fold them up like a butterfly's. To insure that it will be the towrope and not the wings that will break under such conditions the Department of Commerce recently passed a ruling that the strength of the towing cable shall not exceed two thirds the maximum load the wings can carry. The pilot of an auto-towed glider must also be sure to steer a straight course behind the towing vehicle. Otherwise, the cable may give a sudden sidewise jerk on the nose of the machine, which may break off just behind the pilot's seat.

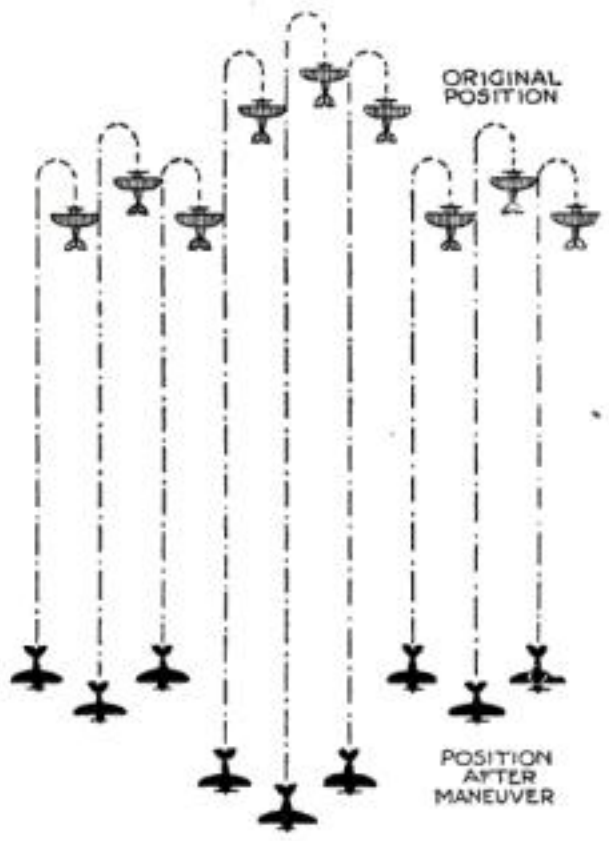
Of all motorless flying, soaring teaches the pilot most. My opportunity to ride the wings of the wind on a Bowlus sailplane taught me things that have made me a better pilot of motored machines. Soaring is a flyer's post-graduate course.

Lone Eagles of War Banished

(*Continued from page 25*)

methods of attack. Will the minds of the seventeen other pilots follow in identical channels with that of their leader?

Every flight with a definite mission is preceded with a detailed discussion of the proposed project. The problem must be thoroughly understood by all the pilots involved. After cruising aloft for some time assume that the leader sights an enemy formation which



In a hundred-and-eighty-degree turn, as diagram shows, each plane turns to the left on leader's signal.

demands an entirely different method of attack. Will his pilots be able to take in the changed condition instantly and execute the proper maneuvers?

A few hand signals are available for definite changes of formation. Zooms and the wobbling of wings serve their purpose as signals. On the whole, however, the number of possible combinations of them is limited.

The use of the radio telephone would help immeasurably. Its adoption, however, would add precious weight to an already overloaded plane. The development of a light, efficient radio telephone may eliminate the present objections, but at this time it is not available.

Any future air battle is almost certain to be of gigantic proportions. A squadron commander will be unable to engage actively in the fight and at the same time effectively direct his pilots. It is possible that the squadron leader will stay clear of the mêlée so that he can get a true perspective of the conflict. His job will be to direct his pilots so that they can take instant advantage of any temporary weakness of the enemy forces.

The recent flight of Navy planes over New York City was a beautiful sight to the person on the ground. Paradoxically, the view of New York to the busy pilots engaged in the flight was a blank. For all the sight-seeing done, they might as well have been flying alone over mid-Atlantic.

Close formation flying requires alertness and eyes only for the plane ahead. There is no time for idle thoughts or gestures. No false moves may be made and no mistakes are tolerated. The man in the plane behind you is in a similar situation and must trust the man behind him. With all pilots paying close attention ahead very little danger is involved. Moreover, if a squadron flies together for any length of time, each pilot learns the characteristics of the other. In this way, he knows just what reaction to expect of another in any particular situation.

For military uses, each particular formation is required to be flexible and extremely maneuverable. Visibility must be provided for all pilots in order that a surprise attack cannot be made on them.

The efficiency of these flying squadrons is tested frequently by unusual maneuvers. A few weeks ago, a spectacular test was carried out in California. Eighteen planes climbed six miles into the air. In perfect formation, they flew more than a mile above the "death line," the point above which a pilot cannot live without using oxygen from a supply tank.

So cold was the air at this great height that a thin, creamy ribbon, composed of frozen moisture and gases from the exhaust, formed behind each machine. These white lines, winding like roadways in the sky, could be seen from the ground although the planes themselves were invisible. Because such streaks would guide antiaircraft gunners in wartime, exhaust line condensers probably will be attached to high altitude pursuit ships of the future.

The basis of all formations is the simple section VEE. This is the familiar group of three planes with the second and third ships flying on each side, above and behind the leader. Three such section groups in a VEE is termed a VEE of VEE's.

When cruising on cross-country flights, each division flies in a loose VEE of VEE's. The proper position is easily maintained and the pilots become less fatigued. This formation is most often used for parades, as it is symmetrical in all respects and hence more attractive to those on the ground.

The planes are easily maneuvered from this position. The path of flight can be changed in any direction instantly. In doing this, simple maneuvers are used, though to the observer below the evolution is complex and attended

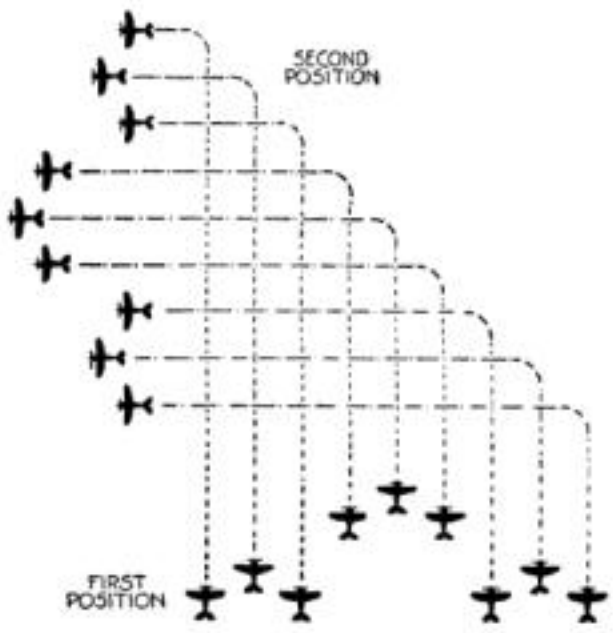


Diagram showing how planes completely reverse positions in a right-angle maneuver in the air.

with great confusion. As the maneuvering signal is given, the ships appear to be diving in all directions. Then, presto! The formation is again flying in perfect order.

THE cross-over turn used by the Navy for ninety-degree turns is probably the most confusing to groundlings. The preparatory signal is the dropping of the wing on the side towards which the turn is to be made. This signal is then passed by each successive pilot. Each flyer must now be especially alert, for the turn may come at any moment. Suddenly, the leader makes a vertical banked turn in the signaled direction. The man on the outside of the turn executes a

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Lone Eagles of War Banished

(Continued from page 184)

simultaneous turn inside of the leader and underneath the third plane, which continues its flight until it is over the steeply banked leader. It then makes a similar turn.

When on the new heading all planes straighten out, they find themselves exactly in position. The two wing-men have changed positions during the evolution. With a compound formation such as a VEE of VEE's the cross-over turn is done within the section as well as by the sections themselves.

The reversement is the quickest method of turning a squadron 180 degrees. The leader signals the proposed turn by skidding his plane violently in the desired direction. As before, each plane passes the signal down the line. When ready, the leader suddenly goes into a nose-low flipper turn. The wing-men execute similar vertical bank turns. When each pilot has reversed his original course he straightens out and finds himself in position.

DURING part of the two above described evolutions the wing-men are blind. That is, they are unable to see their section-mates. This naturally leads to a certain amount of danger. It requires not only confidence in the pilot himself, but he must trust the other flyers implicitly. Long hours are spent in practicing the formations at a safe distance. As the wing-men become more proficient, they are gradually drawn closer in by the leader until the stage of close parade formation is reached.

During exhibition flights, the two-mile-a-minute planes are sometimes tied together with half-inch ropes. They go through their maneuvers and even loop the loop in unison, with the wing of one machine attached to the wing of the next by a thirty-foot cable. Some skeptical onlookers imagine that these cables are made of rubber so they stretch. But they are really manila ropes spliced at intervals with rags so they can be seen more easily from the ground. Such ropes have no practical value. Their only purpose is to demonstrate the skill with which formation flying is accomplished.

In actual warfare, a loose formation is desirable in fighting planes. Each pilot can then devote more time to searching for enemy aircraft. An exact formation serves no useful purpose other than aerial displays. With the enemy in sight, however, the planes will bunch up slightly in order to carry out the plans of the leader more quickly.

Slow, unwieldy bombers, on the other hand, huddle closely together for several reasons. Obviously, they are unable to maneuver against a fighter's attack. In order to drop their bombs accurately, they must maintain a straight course over their objective. In addition, by flying in a tight formation, they are able to bring a preponderance of gunfire against the more activ enemy because of a rear gunner in each ship.

FORMATION flying has no place in commercial aviation. The Department of Commerce specifies that planes shall not fly closer together than three hundred feet. The desired amount of visibility and maneuverability for this type of flying is found in only a few commercial ships.

Moreover, formation flying entails considerable hazard to those who have not the training and equipment received by service aviators. The lives of passengers would be unnecessarily endangered.

Formation flying probably will be used by Army and Navy pilots to thrill an eager audience or to save their own lives in time of war, but the commercial flyer will do well to keep plenty of distance between his plane and the next one.

Quick-Frozen Foods

(*Continued from page 27*)

cold-storage process, dessication, or drying out, through surface evaporation of moisture, takes place in proportion to the surface area of the product exposed to the atmosphere. The oxidation of fats, called freezer burn, resulting in change of color and souring, is most rapid on exposed cut surfaces.

That elusive quality we call flavor often was lost in the past, largely because of evaporation of volatile substances, oxidation of fats, and the absorption of odors. Reducing the area thus exposed, or eliminating it almost entirely by covering the product with a close-fitting, air-tight, moisture-proof wrapping, automatically reduces the possibility of oxidation and evaporation, at the same time keeping out contaminating odors.

Another item is economy of shipping and storage space. Take, for example, a steak. In its unfrozen state, a steak is fairly yielding and flexible. It can be so manipulated as to fit into a rectangular cardboard carton. The same steak, after freezing, would be hard as a rock and impossible to bend. Plainly, ten steaks in cardboard boxes of identical size will be easier to pack for shipment and easier to store in a given space than ten steaks of varying sizes and shapes, frozen unwrapped.

THE control of expansion makes a big difference. The volume of space occupied by one pound of sirloin steak, unfrozen, is twenty-six to twenty-eight cubic inches. When packaged and then frozen, it occupies twenty-nine to thirty cubic inches—very little more. Frozen first and then packaged, it occupies forty-five to forty-seven cubic inches. The ratio is similar in the case of other meat and fish products.

The element of cost also enters in here; not only the cost of storage and shipping space, but of wrapping and packaging materials. This is a factor to be reckoned with, for a new product, to appeal to trade and public, must compare favorably in price with the article it is designed to supplant.

Quick-frozen foods are here, but only to a limited extent. As this was written, more or less experimental sales campaigns introducing them were being conducted in various parts of the country, testing the reactions of the public and testing, also, various types of refrigeration devices specially adapted to the transportation, storage, and merchandising of quick-frozen products.

IN SPRINGFIELD Mass., where the Birdseye foods were first tried out early this year under factory supervision, the results showed that the public was highly receptive to the idea. In Indianapolis, Los Angeles, Palm Beach, Miami, Grosse Pointe, Mich., and many other cities, the big packing companies, also experimenting, have found an eager public demand for quick-frozen foods. But all the producers have been making haste slowly, because although the public seems to be ready to accept these revolutionary foods, the vast majority of stores are not as yet in a position to handle them.

Just as the movie theaters could not show talking pictures until they had installed the necessary sound reproducing equipment, so the hundreds of thousands of stores cannot sell quick-frozen foods until they have adequate refrigerating facilities. Ice boxes are of no use. The ordinary mechanical refrigerator designed to keep foods at temperatures up to fifty degrees is also valueless for the storage of quick-frozen products.

The housewife can use her present ice box, or mechanical refrigerator, for quick-frozen foods, provided she treats them just as she would the fresh variety, cooking them within a short time of their purchase. The storekeeper, however, must be able to keep his stock, until it is sold, in exactly the same marble-hard condition in which it leaves the factory.

If these products are allowed to thaw, and are then refrozen, they cease to be quick-frozen, but become merely sharp-frozen goods, suffering the usual damage from large ice crystals. To preserve them in unchanged condition, it is essential that they be stored in near-zero temperatures, never above twenty degrees Fahrenheit and preferably at ten degrees or lower.

The problem of designing a combination display case and cold storage cabinet capable of maintaining the necessary degree of dry frigidity, even though opened at frequent intervals, will continue to occupy refrigeration engineers for some time to come. Such questions as how to control the circulation of air currents; how to control the moisture which enters when the doors are opened; how to remove the frost, largely due to this moisture, which collects on the cooling coils and reduces their efficiency; how to prevent the glass display windows from becoming fogged; how to provide the right degree of cold at a minimum operating expense; how to keep frost from cracking open the joints of the cabinet; how to illuminate the display without raising the temperature or fading the products—all of these problems have cropped up.

SOME manufacturers of refrigeration cabinets and machinery claim to have solved them. Perhaps they have. The general feeling is that only time will show whether they have or not. It is what a mechanism does in actual everyday use that counts. Many an automobile, exhaustively tested at the factory, has developed "bugs" in the hands of individual users.

Before manufacturers of quick-frozen products can distribute their wares widely, they will be forced to conduct extensive campaigns of dealer education. If they allow their products to get into the hands of retailers ignorant of how to handle them, or lacking the necessary equipment, their foods will be ruined before the consumer buys them. In one instance, an investigator found his company's product reposing on a bed of cracked ice. Question: was the ice cooling the food, or the food cooling the ice?

Packed tightly in properly lined fiber board cases, quick-frozen foods can be shipped long distances without refrigerant, provided they are to be used immediately upon arrival at their destination. In a fifty-pound container, packed solidly full, cartons of quick-frozen fish required seven days to reach a temperature of fifty degrees, at which time their contents were still perfectly fresh.

BUT for distribution to wholesalers and retailers, who must store them until they are sold, quick-frozen foods must be shipped in refrigerator cars or trucks, at Arctic temperatures. For short-haul work, dry ice has been found a satisfactory cooling agent. For longer distances, motor trucks and railroad cars have been developed which will maintain automatically any desired degree of cold. Some of these operate with compressors similar to those used in electric household refrigerators; others are chilled by the silica gel process, which is akin to that used in gas refrigerators, where a tiny flame keeps the freezing fluid in circulation through the cooling coils.

"All very fine," you may remark, "but why the excitement? We buy fresh meats and fish and vegetables in our family. What do we care if there's a new frozen kind?"

There are several (*Continued on page 127*)

Quick-Frozen Foods Exactly Like Fresh

(Continued from page 126)

reasons. If you are like most Americans, you want to know what you are getting when you go to market. You want to be sure you are getting what you pay for.

You are accustomed to expect standardized quality in everything, except in perishable foods. With those you are obliged, more or less, to trust to luck. Unless you are an expert judge of meats, fish, poultry, and vegetables, you have to take the word of your market-man for the condition of the foods he sells you.

Packaged, trade-marked, and guaranteed flesh and farm products, made and kept germ-proof and absolutely fresh by North Pole cold, will change all that. You will know, when you send your small boy out to buy a steak, a duck, a package of raspberries, or whatever, that the article he brings back will be just as good as you could have selected yourself.

THE quick-freezing process promises to benefit not only the consumer but the producer, the packer, and the retailer. It is saving the life of the fish industry by making millions of new customers of people who previously refused to buy fish because they could not get it fresh. It also assures the fisherman of a profitable market for his catch, since its speed makes possible the processing of enormous quantities in a short time.

Meat packers take to the new idea of merchandising their entire output in trade-marked packages because it allows them to safeguard their reputations through more complete control of the preparation of their products for the consumer's kitchen.

And how about the storekeepers? The quick-freezing process will make business infinitely easier for them, too. Take, for instance, the case of the butcher. When he buys a side of beef, he knows what he has to pay for it, but he doesn't know, until it is all sold, how much he can get for it. To make a profit he has to juggle his prices: so much a pound for this cut and so much for that, making some portions that are greatly in demand pay for his losses on the others.

When he is able to buy all his meats ready-cut, wrapped, and weighed, at so much per package, he will know exactly what he can charge and exactly how much he will make. He will be able to buy only those cuts which his particular clientele demands. Also, in case of complaint, he will be in a position to place the blame elsewhere.

NO LONGER will the vegetable dealer be obliged to get up in the middle of the night to go to market before the best and freshest produce has been snapped up by competitors. And no more, by the same token, will the housekeeper be forced to do her marketing early or run the risk of finding everything picked over.

Though it all started with fish, the influence of quick-freezing will spread far. Reindeer meat from Alaska, at the rate of 1,000 carcasses a day, will be made available for shipment all over the world, as will countless quantities of wild Alaskan berries.

Millions of oranges, too small to be profitably sold, will be turned into cash through the sale of their juice, extracted and quick-frozen by the growers and sold to you in solid golden cubes. The succulent stone crab of the Caribbean, which cannot now be shipped because it doesn't keep, will find its way to your table. So will many of the exotic tropical fruits that cannot at present be transported ripe.

Of all the vistas opened to view by quick-freezing, however, perhaps the best is this: when all perishable eatables are quick-frozen and properly kept until used, no more will people say: "This tastes queer. I hope it's all right. I wonder if it'll give me ptomaine?"

Learn Your Flying Young!

(*Continued from page 65*)

the morning of the start, he was sitting in front of the hangar bright and early. He had bought a helmet and a pair of goggles to make the trip, so I gave in and let him climb aboard.

On the way west, I taught him to fly. We struck terrible weather. Battling head-winds all the way, it took us two days to get there. Algrim was air-sick most of the time. Whenever I would look around, he would point down. He wanted to land. But he held onto the stick and learned to fly.

At the end of the trip, I thought he would go back on a train. But he was as wild about flying as ever. He went barnstorming with me later and made a good pilot. In one of the states where we hopped passengers he had a girl, and every night after the day's work was over he would fly off a hundred or two hundred miles to see her.

I've always had a soft spot in my heart for anyone who wants to get into flying and hasn't much money. I have been through that myself. I was fifteen when I soloed a Hisso-Jenny at St. Louis. Six months before I had never seen an airplane. But when the flying bug bit me, it bit me hard.

WHEN I was fourteen, I was a cowboy on the old MillerBox-T ranch in the Texas Panhandle. Down there, planes were scarcer than hen's teeth. One hot day when I was riding range, I heard a great buzzing in the northeast. A big, square-winged bird sailed overhead, coming across the Oklahoma line. It was a plane operated by a pilot who had lost a leg and an arm and had controls specially made for him to use. When I saw it flying through the clouds, going places, I said: "that's the kind of a pony I want to ride."

Two months later, I got to St. Louis and headed for the nearest air field. I didn't have enough money to take flying lessons. So I adopted a couple of planes. I curried them down every day, wiping the grease and dust off the wings. My salary was exactly nothing. After a week or two as "grease monkey," the pilots began giving me hops and letting me hold the controls in the air. I joined the National Guard and got in a little more flying time that way. At the end of two hours and forty-five minutes instruction, I soloed. I have never since felt as I did when I landed after my first solo flight.

"Slim" Lindbergh came to St. Louis right after this. Out of salvaged parts and odds and ends, I built a Standard biplane, and that summer we barnstormed through Missouri and Ohio, hopping passengers in small towns and giving exhibitions of wing-walking, auto racing, stunting, and anything else that would bring in dimes. "Slim" was twenty-two and I was nineteen. On that trip, he taught me more about flying than anyone else has ever done. He was always trying new tricks in piloting and figuring out what he would do if different things happened to the ship. Long before he flew to Paris, "Slim" was one of the best pilots in the world.

He learned to fly when he was twenty. "Jimmy" Doolittle, first to do an outside loop, began at twenty-two. Frank M. Hawks started at twenty. Lieut. Albert Hegenberger, who flew to Hawaii, began his training at twenty-two. "Casey" Jones began at twenty-three. Dean Smith, who went with Byrd to the Antarctic, entered flying school at eighteen and "Eddie" Stinson took his first plane off the ground when he was seventeen. I can't think of a single famous pilot who didn't begin flying before he was thirty.

There isn't any better training in the world for a young pilot than barnstorming. He has to land and take off in napkin-sized fields. He makes forced landings under all sorts of conditions. When he gets done, he can almost fly with his eyes shut. I believe it would be possible to go out today and make just as much money as we did six years ago. Ships are being built now that will get into places that we couldn't work in our old Standard.

Of course, you have to have more than enthusiasm to make a pilot. You must have flying nerve. But flying nerve alone isn't enough. One of the most fearless students I ever saw couldn't learn to fly. We worked with him for twenty hours and gave him up as a bad job. He couldn't land without trying to burrow a hole in the field. But one morning when nobody was around he came to the field, cranked up a ship himself, and took off. He was going to solo if he broke his neck.

When we arrived at the field, he was still buzzing around trying to make up his mind to land. Finally, down he came. We expected him to crash in, sure. He hit with the tail high, rabbited across the field in half a dozen hops, groundlooped with one wing dragging, and slid to a stop. That landing scared us stiff. But it didn't scare him.

Later, he convinced a man out West that he was an expert pilot and got a job ferrying planes to another town. On the way across, the engine cut out and he had to make a forced landing. He missed his field entirely and mowed down a flock of trees. When the owner saw what was left of his plane, he said: "Well, I couldn't have done much better with an ax."

In spite of his courage, this student could never learn to fly safely. He was too awkward, too heavy-handed on the stick. Other students I remember had natural ability but they lacked nerve. One little crack-up scared them out.

Once, I was instructing a girl who was almost ready to solo. We were up 2,000 feet when the radiator broke and steam and water poured back over the cockpits. We landed all right, but a funny thing had happened. The girl had been wearing a flannel dress. The water made it shrink so much she wouldn't get out of the plane until we pulled it across the field and into a hangar. That freak accident ruined her nerve and she quit flying.

I think older people are more apt to lose their nerve in the air than younger ones. That is another reason for beginning early.

A FEW years ago, a man of about forty-five gave me the scare of my life when he lost his head and "froze" to the control stick 3,500 feet in the air. I was hopping passengers at a little place about thirty miles east of Jamestown, N. Y. This man said he wanted to see some real stunts. He said he wasn't afraid of anything, from grizzly bears to tornadoes. Fortunately, I got plenty of altitude before I started the first loop.

The old Jenny stalled for a moment at the top of the circle. Most pilots grab a handful of longerons, the lengthwise bracings of the fuselage, when they are upside down. They don't take any chances with their safety belts breaking. But, instead of grabbing a longeron, this passenger grabbed the control stick and held on for dear life. Before I could break him loose, he had pulled the nose down in a snap arc that sent us squashing through the air for fifty feet. If he had held on another second, we would have been in a spin.

Few students freeze to the stick. Most of them try to do something in an emergency, even if it is the wrong thing. The only student who is absolutely hopeless is one that gets bewildered and doesn't try to do anything when he is in a jam.

If you want to get a little taste of what a tail spin is like, look into the rear-view mirror of an automobile while someone else swings it in a circle. The (*Continued on page 129*)

Learn Your Flying Young!

(Continued from page 128)

way the ground appears to be whirling around is the way it whirls in a spin—only in a spin it whirls a thousand times faster. It is easy enough for a beginner to get bewildered in a plane. Even experienced pilots get dizzy if they look back at the tail surfaces when they are in a vertical bank. Oftentimes, in such turns, the horizon shoots past the nose at 1,200 miles an hour. And, when the pilot looks back, it appears to be streaking past the tail at the same speed, *in the opposite direction!*

One student I had a few years ago got bewildered even before he was off the ground. He had had four lessons, but he didn't have any idea what it was all about. I told him to crack the throttle open about an eighth of the way while I swung the "prop" to start the motor, and then to ease it ahead a little more while I held one wing to swing the ship into the wind. The OX motor started with the first turn of the "prop." I got to the wing tip and waved to give her a little more gas. Instead, he slapped on almost full gun. The OX bellowed. The ship spun around, slung me a dozen feet away and charged down the field. Halfway to the other side, it groundlooped and came back heading right for me, the propeller a circle of steel blades in the sunlight.

I MADE a dash to one side and the ship passed me in a cloud of dust. It groundlooped again and came tearing back. Just before it reached me, the student shut down the motor and I thought everything was going to be all right, when he slapped it on full, pinwheeled toward a fence, pulled back the stick, and zoomed right into a tree. When the dust cleared away, he was sliding down the fuselage unhurt. But the ship looked like a couple of elephants had played with it.

You can usually size up a student the first time you meet him. If he is observing, sees things, and looks right at you when he talks, instead of keeping his eyes on the ground or continually shifting his gaze, he is likely to make a good flyer. After the third lesson in the air, you know pretty well what he will do in an emergency.

It doesn't require either great skill or great courage to pilot a modern airplane. Natural ability helps, but present-day methods of training make skillful pilots of students who show little natural ability at the beginning, if they are determined to fly and are not too old.

AT ROOSEVELT FIELD, practically every day, a flock of boys ride around on bicycles, like a school of minnows, seeing everything there is to be seen. They talk the lingo of the air, and refer to the bicycles they ride as "ships." The other day, when they started off, the leader called: "Come on. Let's hop off. We have a tail-wind to Hempstead."

Boys like that will make the crack pilots of tomorrow. They are familiar with planes and the way they fly. They have learned much that will save them time later. They have started early.

SEEKS REGION WHERE LIGHTNING IS SEVERE

MOST persons prefer to avoid spots where lightning is severe; not so Edmund A. Evans, of the General Electric Company's research staff. Recently he asked the superintendent of the Pike National Forest, Colorado, where lightning bolts are thickest. He wanted to compare them with thunderbolts made in the concern's Pittsfield, Mass., laboratory. The superintendent directed him to Devils Head Lookout, near Sedalia, Colo., where lightning is most frequent.

Secrets of Sleep

(Continued from page 23)

driving mechanism is operated thus: Pinion P^1 (see photograph) connects with the camera shutter and film rewinder. The camera automatically changes its film after every exposure, like every other motion picture camera. The spring S pulls up a lever to the other end of which is attached a rack. This engages with pinion P^1, which operates the camera shutter. Then the motor M starts, and through a worm and gear operates pinion P^2 at slow speed. Pinion P^2, engaging the rack, pulls it back into the reset position. The flyball governor G^1 controls the timing of the exposure, and the flyball governor G^2 controls the speed of the rewind motor, so that it takes a full minute to push the rack up, ready to operate the shutter when released by the contact attached to the bed. When the rack reaches top position, the rewind motor is shut off. The lens is used at f 3.5 diaphragm opening and the exposure is three tenths of a second.

In the pictures 1 to 9 are shown the various poses in which one typical sleeper rested in the course of one typical night, between 1.26 A.M. and 3.30 A.M. In all, the subject took thirty grossly different poses between 11.09 P.M. and 6.46 A.M. Even that number shows a smaller variety of changes than a sleeper usually shows. The time during which he held each of the thirty poses varied between slightly more than one minute and forty-eight minutes, an average of 15.8 minutes.

This sleeper favors a pose which we call a "kitten-coil" (see pictures 2, 4, and 5). He assumed it fifteen times during the night. While taking this position, he lies on the left side somewhat more than on the right.

Sometimes, he sleeps sprawling on his front and side, in a position that resembles the beginning of a stroke in swimming. This posture is greatly favored by most sleepers. But more often he lies on his back (pictures 1, 3, 6, 7, 8 and 9). On bedding equipment of this kind, he occasionally lies entirely prone.

It is noteworthy that, when lying on his back, he never does so in such a manner as to distribute his weight equally on both sides of the pelvic arch; in other words, he never lies really "flat on his back." Whether he lies on his back or on his stomach, he always gives the spinal column a decided bow sideways as well as backwards. This is done by all the sleepers we have observed.

All the poses that are held for several minutes, we found, are very much contorted. None of them suggests "complete relaxation"; some muscles must work while others rest. The reason for this seems to be that those positions which permit the greatest muscular relaxation do not afford a disposition of the internal organs that satisfies the sleeper.

A great many of the poses assumed by a sleeper during a night are "mirror-images," or exact opposites, of others. In the case of some subjects, as many as three fourths of all positions taken are mirror-images of others. Half of these would be impossible if the sleeper had to share his bed with another person. It also is evident that the sleeper's freedom of choice of pose would be restricted considerably if his bed were made narrower (see pictures 1, 2, 4, 5, 7 and 8).

The ideal bed, it appears from our investigations, is one that permits the sleeper to take the greatest possible variety of comfortable poses, and to hold each of them with a minimum of effort. This ideal seems to be most nearly realized in a strong, silent, upright-coil bed spring, combined with an interior-spring mattress. The mattress may be padded either with hair or felt; but the most satisfactory are those with the most steel coils.

Pork Chops from the Sea

(Continued from page 55)

appear through the summer off both coasts, to all appearances headed northward. This movement seems to continue throughout the summer and well on to the end of October, or even later on the Pacific side. Their migration back south has not been noted, but it is suspected that they move much farther out to sea for the return voyage, possibly even crossing the Pacific and going down the coast of Asia. This, however, is pure conjecture.

Most of the swordfish taken for commercial purposes are those of the saber, rather than the rapier; that is to say, "broadbills" and not "marlins," which are left to furnish sport for the hook-line-and-rod angler. The fact is that the flesh of the marlin is coarser and not so well flavored as that of the broadbill, hence meeting with low demand and slow sale.

Most of the broadbills brought into the United States are found by watchful lookouts at the mastheads of the larger boats and in the pulpits of the smaller craft, while the great fish are asleep on the surface of the sea. The broadbill rests with only the tip of its upper tail, about half its dorsal fin, and possibly a little of the end of the sword —which is a projection of the upper jaw— showing above the water. Only excellent eyesight can find these three tiny black signals on the uneasy floor of the sea, and only a trained eye can differentiate between the fins of a shark and those of a swordfish.

Usually, the broadbill travels in solitary state; occasionally two will be found within a few miles of each other, but there is no evidence to show that they are mates or that they are even traveling together. Old-timers in this fishing say they never have seen more than two swordfish in the same area of ocean, and that they have never obtained any evidence of family life among the broadbills, such as exists among whales, sharks, porpoises, and other large creatures of the sea.

As the armed master of the waters floats along, more than seven eighths of his torpedo-shaped body is only a shadow in the sea. But the harpoon must be driven into him just back of that high, curved dorsal fin. If thrust into the head, the barb may not take hold; if too far back, the barb may tear out.

So the boat, be it twenty-five or 100 feet long, moves slowly up and down and across the lane of migration of the swordfish until one is sighted. Then the course is altered, so slowly as to create as little disturbance as possible. Once the man at the wheel has laid his ship directly on the broad-bill, the engines are stopped, to eliminate vibration, and the momentum of the boat allowed to carry it down on the huge fish. The harpooner, in his pulpit, grasps the long spear, with its slender fifteen-inch steel head and two-inch barb, and leans far out over the rail of his dancing perch. Yet he is helpless until the helmsman puts him in position.

If the swordfish is resting, fearless of anything in or on the sea, the pulpit presently rises above him, the harpooner drives down his long and slender weapon, holds it an instant to see that the barb has taken hold, and lets go just as the fish hurls itself forward at express-train speed to get away from there. As the man in the pulpit releases the harpoon, he shouts "Strike," and the keg-buoy at the end of the line is hurled overside and goes bobbing off on the trail of the wild hog of the sea. The man in the skiff, which has been dropped outboard, already is on his way, and the larger craft follows leisurely until it is time to gather in the 100 to 1,000 pounds of meat.

Taking Golf Swing Apart Shows Left Side Does It

(Continued from page 39)

of the details I have just mentioned. Small wonder, then, that the swing is generally regarded as a complicated affair!

Just how and where the player puts the force into his shot determine what the action of the swing will be. If the force does not have its origin in the proper set of muscles, the action of the body, arms, hands, and club are impossible to control.

In the correct swing, the force should originate in the muscles of the back and be transmitted by the muscles of the left shoulder, left arm, and left hand so that the force is flowing from the center of the body out to the clubhead through the extensor muscles of the left side of the body. Then the head of the club acquires a speed that makes its path both accurate and smooth. The effect is the same as that produced by whirling a weight attached to a cord —the faster you whirl it, the truer the weight travels and the greater the momentum it acquires.

THIS same principle, which is of course an application of centrifugal force, in the golf swing results in what might be termed a "hammering action."

The main difference between a good golf player and a poor one is that, in making a stroke, the poor player uses the muscles of the *right* side of his body almost exclusively, permitting the left side, and particularly the left hand and arm, to travel along merely as a "passenger" as the club is swung. In hitting the ball, the good player confines the use of the muscles on his right side only to those of his thumb and forefinger, which exert a small pressure on the club merely to steady the actively dominant muscles of the entire left side of the body.

In beginning the swing, the club is raised, stretching the extensor muscles of the entire left side of the body, from the left little finger through the left arm and left shoulder into the muscles in the left side of the back. These same muscles are used in swinging the club down to meet the ball. In the downward part of the swing the club bears to the left arm virtually the same relation a hammer or axe might bear if swung backward with the left hand at the full reach of an extended left arm.

THIS application of centrifugal force is the only means of meeting all the requirements of the correct golf swing. Although the full swing only is pictured in the accompanying illustrations, the same action is employed, either wholly or in part, in making all shots. In the correct swing for any shot of any length, the mechanics are the same as in the full swing; the action is similar and the same muscles are employed to a greater or less degree according to the flight of the ball desired.

In picture No. 1, in which I show the starting position for the swing, you can see the "feeling out" of the extensor muscles in the whole left side of the body, the major portion of body weight being supported by the fully extended left leg. The only muscles that are flexed are those used in gripping the club firmly with the left little finger and between the right forefinger and thumb.

Picture No. 2 shows the top of the swing. Here the weight of the body has been transferred to the extended right leg by means of a sideward swing of the hips. The muscles are coiling backward from the left hand through the left arm and left shoulder into the muscles in the left side of the back.

The initial movement in the down swing is the transferring of the body weight to the left leg and picture No. 3 shows the process of swinging the club halfway down to the ball in a "hammering action" that finds the force originating in the mus- (Continued on page 138)

Taking Golf Swing Apart Shows Left Side Does It

(*Continued from page 131*)

cles of the back and flowing outward through the extensor muscles of the left arm, thereby generating greater speed and power as the head of the club approaches the ball.

Picture No. 4 demonstrates the correct position of the body, arms, hands, and club as the clubhead is striking the ball. The fully extended left arm and the club form the radius of the swing, enabling the face of the clubhead to strike the ball exactly at right angles to the line of flight, which is essential if the ball is to travel straight and true in the direction desired.

Picture No. 5 is "after impact." It must be remembered that the path of the clubhead coincides with the line of flight of the ball only at the brief instant when ball and club actually meet. Consequently, whatever action takes place after the ball has been struck is due entirely to the momentum of the swing.

IN picture No. 6, the white line shows the entire path the clubhead has described in the swing. In the down swing, at impact, and at the finish of the swing, the weight of the body is supported mainly by an extended left leg. Note that the chin has remained pointed to the right at all times. This not only helps bring into play the proper muscles but enables the player to time and balance the entire swing.

The action I have described—the use of the muscles from the back, left shoulder, left arm, and left hand—is perfectly natural, even though most persons, particularly those who have played golf, will find it unfamiliar. Golfers who have formed the habit of using other muscles in their play will find it particularly hard to learn. But it is the correct way of making a golf swing and consequently well worth the effort necessary to acquire it.

Light Speed Now Sought as Key to Universe

(*Continued from page 18*)

ful beam passes to one of the eight perpendicular and highly-polished faces of a revolving mirror, turned by compressed air at 512 revolutions per second.

This beam of light is deflected by this mirror through the glass-inclosed opening to the interior of the vacuum tube. There it is picked up by another mirror, and shot back and forth, within the tube, between five other mirrors of various shapes and sizes, until, after it has traveled a known distance (approximately ten miles) in the airless pipe, it returns, to impinge again on the same face of the revolving mirror, outside the tube. Thence, the beam of light is thrown to a final resting place on a stationary mirror.

DURING the infinitesimal time required by the light ray to travel up and down the tube, the face of the rotating mirror has moved a short distance. There is formed, therefore, an angle between the beam of incoming light from the ion arc and the returning beam from the tube, between the two points at which they respectively strike the same face of the rotating mirror. The speed at which this mirror moves is known with extreme accuracy. When it is moving at normal of 512 revolutions per second, its second harmonic note is high C. Doctor Michelson has at hand a tuning fork which, vibrating also 512 to the second, hums high C. If the speed of the rotating mirror varies in the slightest degree, it hums out of tune with the fork, and the observer immediately notes it. Thus an "ear for music," which Doctor Michelson has, enters into the tests for the speed of light. Since the speed of the wheel, the distance between the points of light on the face of the mirror, and the distance (*Continued on page 133*)

Light Speed Now Sought as Key to Universe

(Continued from page 132)

the light beam traveled to and fro in the tube are known accurately, it is a matter of careful mathematical calculation to calibrate the angle, compare its arc with the speed of the mirror, and obtain the time required by the light beam to cover ten miles. The rotating mirror is the key to the experiment; and the master of the rotating mirror is Doctor Michelson's ear, sole arbiter between the tuning fork and the mirror's song.

But there are many other interesting, and almost equally important, features to this largest vacuum tube in the world. There are five separate departments, so to speak, in the equipment. First of all, there is the huge tube; then there are the mechanical, electrical, and pneumatic systems by which it is operated, as well as the optical system through which the actual experiment is conducted.

THE tube sustains an external collapsing pressure of 2,160 pounds to the square foot. There are two iron tanks, slightly larger than the tube, at each end, holding the mirrors that throw the light beam back and forth through the tube, and the motors that rotate these mirrors at uniform, synchronized speed. While the tanks are mounted on concrete foundations, the mirrors have their own separate steel standards, since they must remain vibrationless, regardless of the movements of the tube due to temperature changes, movement of air on the outside, or other stresses.

As shown by the accompanying diagram, these mirrors must reflect a straight beam of light (though reflected in some instances at varying angles) up and down the tube for a total of ten miles, and then send that same beam out through the small window in the side of the control tank. The thirteen motors housed inside the tanks are controlled from one switchboard, on the outside. Wiring and operation of motors and switches must be perfect before installation and before the tube is sealed and a vacuum created, since it is wellnigh impossible to correct this electrical system after the tube has been closed and the air removed.

Aside from the compressed air which operates the eight-faced rotating mirror, humming its high C on the outside of the tube, the removal of the air in the great pipe is one of the interesting features of the pneumatic department of the experiment. The rotary pump, driven by a five-horsepower motor, during the first half hour or so of operation drew out 100 cubic feet of air each minute.

Then the pump came in for harder work on the 40,000 cubic feet of free air originally in the pipe, until a twenty-two-inch vacuum was reached, when there was a slight easing of the work until the twenty-eight-inch vacuum was attained, when the pump was taking only three cubic feet a minute from the tube. If pumping had been continued forever it is unlikely that the last molecule of air could have been removed, but after two days of steady labor a vacuum of thirty feet was reached.

This means, according to the scientists, that only a cupful of molecules of free air remained in this mile-long pipe. One may imagine how thinly these are diffused through 40,000 cubic feet of space, corresponding very nearly to the tenuous space between the outermost stars. Through this, instead of a light ray from the sun, there goes flashing a beam created by man with an arc lamp, reflected from each of the five mirrors inside.

Everything else changes, but light in a vacuum *always* moves at the same speed. Just what that speed is, Doctor Michelson is trying to learn, so that not only this earth, but the entire universe may be measured as accurately as man ever will be able to measure it.

How to Get an Air-Tight Patent

(Continued from page 42)

engineer (1781–1848), is generally regarded as the inventor of the locomotive. But he did not build the first locomotive which ran on iron or other rails. Earlier inventors had produced steam locomotives which pulled trains, but their engines were so heavy that the rails often broke under them. Stephenson invented the combination, still in use, which increased the draft in the locomotive chimney so that a light engine produced sufficient steam to draw a train carrying enough passengers to pay the cost of pulling the train by locomotive.

WHAT Stephenson did was to turn the steam exhaust from the engine cylinders into the smokestack so as to draw more air through the fire, which burned more rapidly and brightly as a result. Stephenson was called a great inventor because his locomotive drew a heavy train, as trains went in those days, without breaking the rails. The earlier locomotives would not break our modern rails. In other words, they were ahead of their time, and for that reason their inventors are considered unsuccessful and unfortunate.

Even men commonly rated as successful inventors sometimes are unfortunate enough to make an invention so far ahead of its day that it is classed as a laboratory curiosity. Thomas A. Edison was one of these unfortunate inventors when he discovered what is known as the "Edison effect," an invention that forms the basis of the radio detector and radio amplifying tubes of today.

Long before Marconi or anyone else had sent signals by radio, in fact as early as 1884, Edison discovered that he produced an electric current, which scientists then could not explain, when he turned on the usual current through the filament of an electric light bulb if there was, inside the bulb, a patch of tin foil.

The unexplained current went from the tin foil to the usual conductors carrying the usual current. This bulb with its patch of tin foil was really what we now call a two-element radio tube; in other words, a radio tube without the usual grid. And we now know that the current is caused by the electrons which leave the heated filament and strike the tin foil. But any patent on that two-element tube or lamp of Edison expired before the invention was found to be useful in radio work or, for that matter, in any other kind of work.

ANOTHER unfortunate inventor who was too far ahead of his time was the marine architect who, in 1857 or 1858, designed the *Great Eastern*, the first steamship over 500 feet long. He invented and put into that ship the system of internal bracing which makes possible the modern steamers of 500 or 1,000 feet length. But the *Great Eastern* was a financial failure, and it was almost twenty-five years before the next steamer was built which needed such bracing. By that time all patents the designer had obtained had expired, and later designers used his system without paying him a cent in royalties.

The fortunate inventor is the one who is clever enough to meet the needs of his own day and lucky enough to fall into the hands of a skillful attorney. A striking example of this kind was the case of the man who obtained a patent on a fireproof safe having hollow walls and water-filled tubes of easily fusible metal placed within the walls. In a fire the metal tubes melted and the water became steam, forming a veil or curtain around the inner safe to keep off the great heat.

This inventor brought a suit for infringement against a man who filled the hollow walls of his safe with alum, a chemical compound containing sulphate of aluminum and almost half its weight in water, and he won the suit because alum, on account of its great water content, gives off steam when heated to a high temperature. The court undoubtedly was right in holding that the alum-filled safe-wall infringed the water-filled metal-tube safe-wall, but only a skillful attorney would be able properly to handle such a suit.

One inventor, who had patented a method of welding cast iron, found that people who ought to be called infringers could easily get most of the benefit from his invention without infringing the claims because the patent entirely failed to mention one important feature of the process. He asked me to obtain a reissue of his patent with a changed specification and with broader claims. I had to tell him that such a proceeding was hazardous, but on further study I found that the weakness of the patent could be overcome and the hazard of a reissue avoided by applying for a patent on the welded joint produced by his method.

FORTUNATELY the joint had not been in public use for two years nor had it been described in a publication during the two previous years, either of which would have prevented us from getting a valid patent, so the patent on the joint would be perfectly good so far as the law was concerned. The patent was obtained, and the inventor probably has made a fortune out of it since.

Every inventor, then, should hang these four points as a motto on his laboratory wall:

First, go to a capable and honest attorney and insist on a full specification, and claims which define the vital points of your invention.

Second, remember that selling an invention is a business proposition. Consider only far-sighted prospective purchasers and be sure they are honest.

Third, don't lose heart when the first prospective buyer or the first attorney you consult does not understand the possibilities of your invention.

Fourth, don't let the red tape and delays at the Patent Office discourage you. These disgraceful conditions doubtless will be rectified if all persons interested continue a country-wide agitation for the much-needed reforms by writing to their Congressmen and to this magazine or by protesting in other ways that will make an impression upon Congress.

Errors the Camera Put in Picture

(Continued from page 40)

Here is the complete list of errors in the picture on page 40.

1. George has placed the jack under the fender.
2. There is no brake drum on the rear wheel.
3. There are four spokes missing from the rear wheel.
4. The rear wheel is off the ground.
5. The girl's arm goes through the car window.
6. Handle of rear door is on wrong side.
7. Front door has no hinges.
8. Handle of front door is on wrong side.
9. The pole against which George leans ends in mid air.
10. The owner of the car has only one leg.
11. The front wheel of the car does not match the rear wheel.
12. The handle of the gasoline pump, at left, points in the wrong direction.
13. A lamp is hanging without support above the wires.
14. The lamp post, at left, casts its shadow in the wrong direction.
15. This post passes through the balustrade of the steps.
16. One of the steps is missing.
17. The lamp post, at right, passes through the concrete wall.

Here's an Easy Way to Learn Radio Symbols

(Continued from page 70)

the finger that makes contact with the resistance.

In the simplest form of radio set using a single tube, headphones would be used to get the sound to the ear. A pair of headphones are shown drawn as they actually appear and next to them appears the symbol which is quite obviously nothing but a simplified and conventionalized picture of a pair of headphones.

After you have studied these symbols, look over the theoretical wiring diagram which shows a one-tube set. At the left appears a symbol for the antenna which is connected to a coil *A*, the other end of which is connected to the symbol for the ground connection. Then comes the coil and condenser symbols *B* and *D*, and the connection from one end of the coil and condenser combination leads to one plate of the grid condenser *F*.

The grid condenser, being a fixed condenser, is represented by two parallel lines. The grid leak *G*, which is nothing but a fixed resistance, is represented by the same zigzag line used for the resistance element in a rheostat.

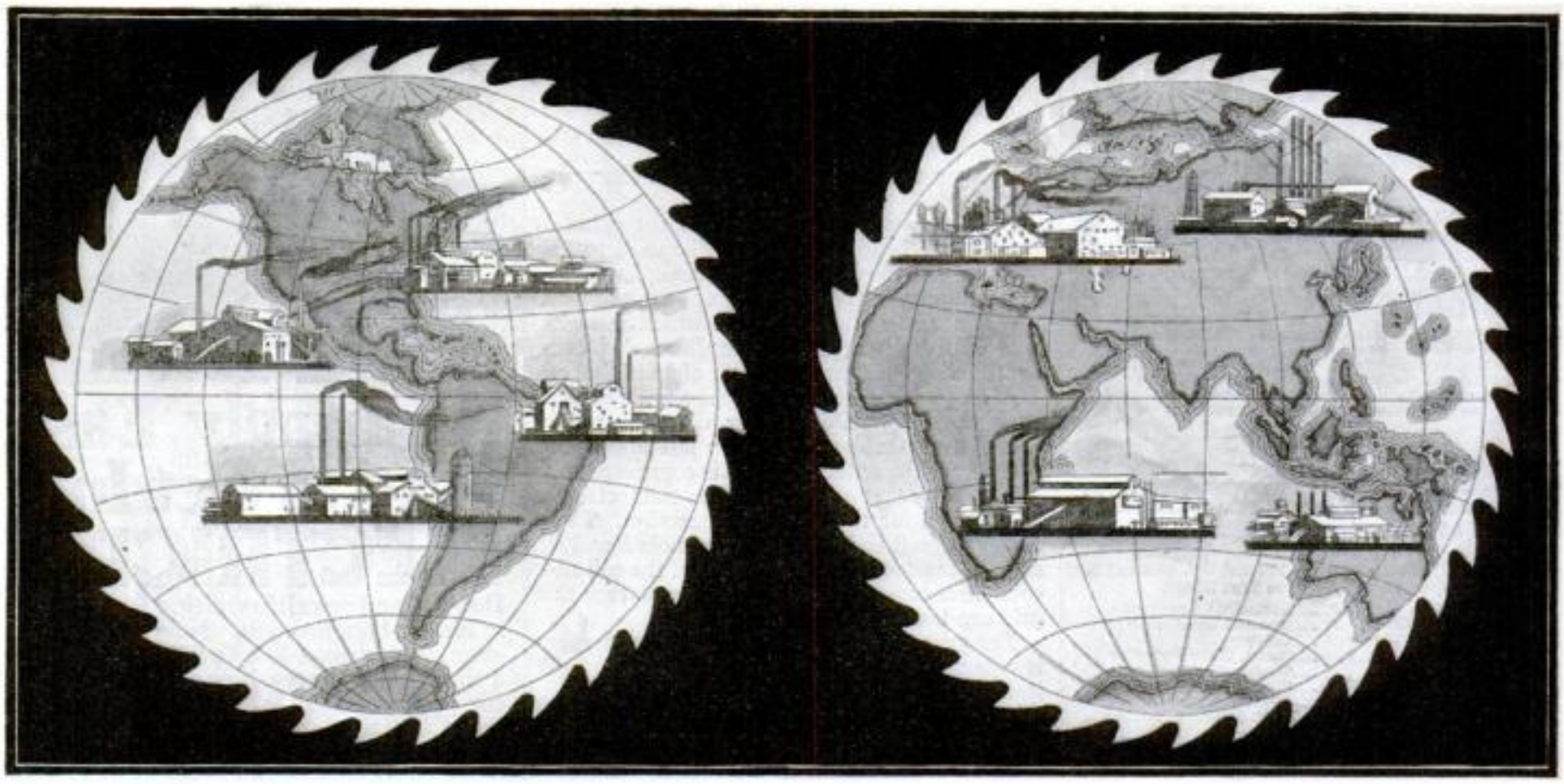
THE other end of the grid condenser is connected to the grid of the tube *J*. The filament is connected with one terminal to a binding post represented by a large dot and the other end is connected to a suitable rheostat *H*. The other terminal of the rheostat is connected to a large dot representing another binding post. The plate of the tube is connected to a coil of wire *C* (in this circuit called the tickler) and the other end of this coil is connected to one terminal of another variable condenser *E*. The remaining terminal of the variable condenser is connected back to the filament circuit.

There are two methods of indicating by symbols whether wires cross each other without making connection or actually make connection. One way is to make a little looped curve in one of the wires to indicate that it is bent around the other wire and does not touch it. This method is used in the diagram shown. The other method is to let the lines cross but to consider that they are not connected unless a dot is placed at the crossing.

The remaining parts in the one-tube diagram consist of a radio-frequency choke coil *K*, which is connected to the plus B binding post by way of the headphones *L*. The symbol for a radio-frequency choke is the same as that for the tuning coil.

A THEORETICAL diagram is useful only if you know the electrical specifications of the parts represented by the diagram, but that of course would be true of any kind of a picture of electrical parts since there would be no way to show in a picture that a coil had so many turns of wire or that a resistance had a value of so many ohms. When two or more coils are represented and they are to be placed so that they work with each other, they are drawn either side by side as *A* and *B* or end to end as *B* and *C*. If the coils are not supposed to work with each other, and it is necessary because of space limitations to draw them close together, they are always shown at right angles to each other.

Beginners often are puzzled by battery connections. In the diagram shown there are only three binding posts. Yet two batteries would have four terminals. However, if the binding posts are properly marked there should be no trouble. The A battery terminals are connected to binding post marked A plus and A minus, and the B battery terminals are connected to binding posts marked B minus and B plus. The fact that in some diagrams one binding post is labeled for two different wires should not prove confusing, since most binding posts are sufficiently large to hold several wires.



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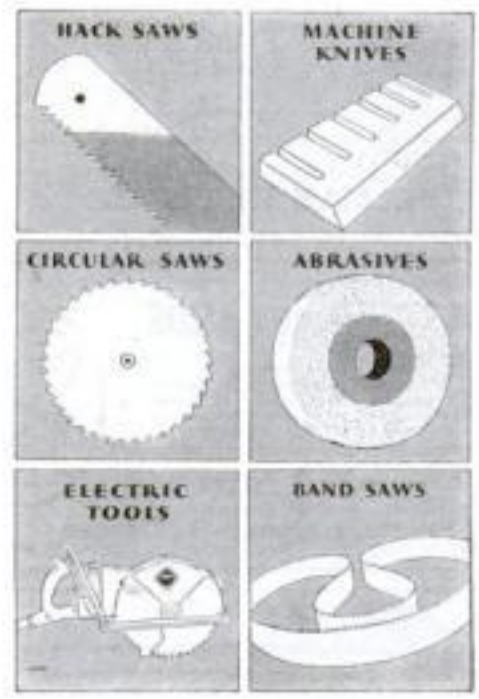

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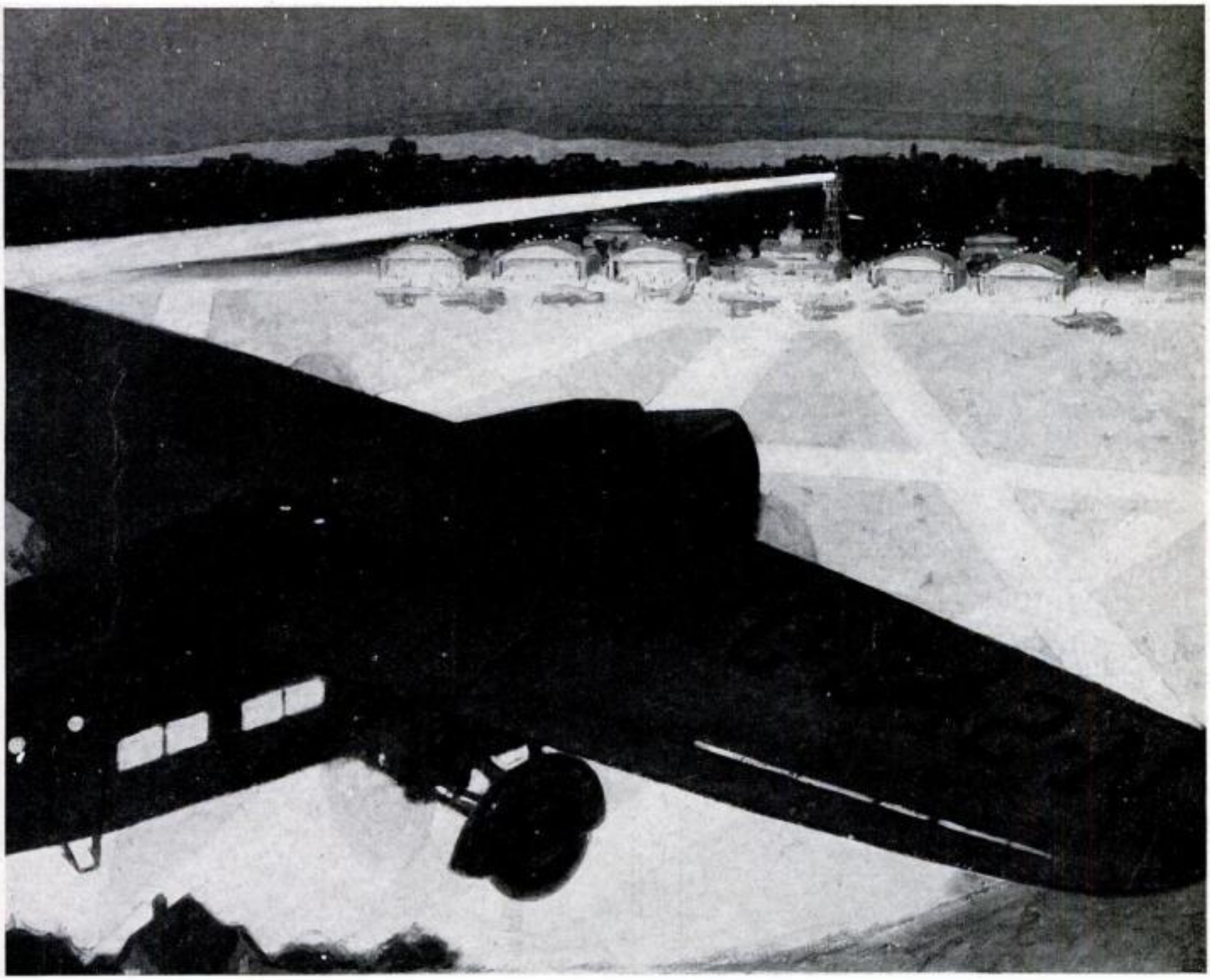

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